

IN THE MATTER OF:

Raritan Bay Slag Superfund Site
Middlesex County, New Jersey

NI. Industries, Inc.,

Respondent

U.S. EPA Index No.
CERCLA – 02-2014-2012

ADMINISTRATIVE ORDER

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I. INTRODUCTION AND JURISDICTION

1. This Order directs NL Industries, Inc. (the “Respondent”) to perform work in accordance with this Order and all attachments that is necessary to complete the remedial design of and implement the remedy described in the Record of Decision for the Raritan Bay Slag Superfund Site (“Site”) located in Old Bridge Township and Sayreville Borough, Middlesex County, New Jersey. This Order is issued to the Respondent by EPA pursuant to the authority vested in the President of the United States by Section 106(a) of CERCLA, as amended, 42 U.S.C. § 9606(a). This authority was delegated to the Administrator of EPA by Executive Order 12580, dated January 23, 1987, and was redelegated to EPA Regional Administrators on September 13, 1987 by EPA Delegation No. 14-14-B. This authority was further redelegated on November 23, 2004, by the Regional Administrator of EPA, Region 2 to the Director of the Emergency and Remedial Response Division by EPA Region 2 Delegation R-1200.

II. DEFINITIONS

2. Unless otherwise expressly provided in this Order, terms used in this Order that are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in CERCLA or in such regulations. Whenever terms listed below are used in this Order or in its appendices, the following definitions shall apply:

- a. “CERCLA” shall mean the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. § § 9601-9675.
- b. “Day” shall mean a calendar day. In computing any period of time under this Order, where the last day would fall on a Saturday, Sunday, or federal or state holiday, the period shall run until the close of business of the next business day.
- c. “Effective Date” shall mean the Effective Date as provided in Section XXVI.
- d. “EPA” shall mean the United States Environmental Protection Agency and its successor departments, agencies or instrumentalities.
- e. “Lead containing materials” or “LCM” shall mean any material(s) containing lead at any concentration, including, lead slag, mattes from smelting furnace operations, lead battery plates, lead battery casings, lead/acid batteries and any components thereof.
- f. “NCP” shall mean the National Oil and Hazardous Substances Pollution Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, and any amendments thereto.
- g. “NJDEP” shall mean the New Jersey Department of Environmental Protection or any successor departments or agencies of the State.

h. “Paragraph” shall mean a portion of this Order identified by an Arabic numeral or an upper or lower case letter.

i. “Performance Standards” shall mean cleanup levels and other measures of achievement of the goals of the remedy selected in the ROD and the SOW, including the standards and other measures of achievement set forth or referenced in Section 8.5, Section 12.4 and Table 5-2 of the ROD and/or in Sections 1.2 and 1.3 of the SOW.

j. “Project Coordinator” shall mean the person designated by the Respondent who will be charged with the duty of being at all times knowledgeable of the performance of all Work performed pursuant to this Order.

k. “ROD” shall mean the EPA Record of Decision relating to the Raritan Bay Slag Superfund Site which EPA signed on May 23, 2013 and all attachments thereto. The ROD is incorporated into this Order and is an enforceable part of this Order. The ROD is attached to this Order as “Appendix A.”

l. “ROD Remedy” shall mean the remedy selected in the ROD, including the remedial design and the remedial action associated with the remedy selected in the ROD.

m. “Remedial Project Manager” shall mean the person designated by the EPA who will be charged with the duty of being at all times knowledgeable of the performance of all Work performed pursuant to this Order.

n. “Respondent” shall mean NL Industries, Inc., and includes its officers, employees, agents, subsidiaries, assigns and successors.

o. “Section” shall mean a portion of this Order identified by a Roman numeral and includes one or more Paragraphs.

p. “Site” shall mean the Raritan Bay Slag Superfund Site located in Old Bridge Township and in Sayreville Borough, Middlesex County, New Jersey. A map showing the Site is attached to this Order as “Appendix C.”

q. “Statement of Work” or “SOW” shall mean the statement of work which is attached to this Order as “Appendix B.” The SOW is incorporated into this Order and is an enforceable part of this Order as are any modifications made thereto in accordance with this Order.

r. “State” shall mean the State of New Jersey.

s. “Supervising Contractor” shall mean the principal contractor retained by the Respondent to supervise and direct the implementation of the Work under this Order.

t. “United States” shall mean the United States of America and each department, agency, and instrumentality of the United States, including EPA.

u. “Waste Material” shall mean: (i) any “hazardous substance” under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (ii) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); and (iii) any “solid waste” under Section 1004(27) of RCRA, 42 U.S.C. § 6903(27).

v. “Work” shall mean all work and other activities that Respondent is required to perform under this Order, including, but not limited to, tasks described in the SOW and any activities required to be undertaken pursuant to this Order.

III. FINDINGS OF FACT

3. The Site is located in Middlesex County, New Jersey. The Site includes, among other areas, a 2,200 foot long seawall along the shoreline of Raritan Bay in Old Bridge Township (the “Seawall”), an 800 foot long jetty on the western side of the Cheesequake Creek Inlet in Sayreville Borough (the “Western Jetty”) and Margaret’s Creek, a 47 acre undeveloped wetland in Old Bridge Township (the “Margaret’s Creek Sector”). (See Appendix C)

4. On September 21, 2009, the Site was placed on the National Priorities List (“NPL”).

5. In 2013, EPA completed a Remedial Investigation and Feasibility Study (“RI/FS”) for the Site. Among other findings, the RI/FS concluded that lead was the primary contaminant of concern at the Site and that lead, at concentrations higher than human health and ecological risk-based levels, existed in the Seawall, in the Western Jetty, in Margaret’s Creek and in the soil and sediment throughout the Site.

6. On May 23, 2013, EPA issued a Record of Decision (“ROD”) which selected a remedy (the “ROD Remedy”) for the Site.

7. The State of New Jersey concurred on the EPA selection of the ROD Remedy by letter dated May 8, 2013.

8. Lead is the primary hazardous substance of concern detected in the soils, sediments, and surface water at the Site.

9. The hazards posed by lead at the Site include, but are not limited to, the threat of dermal contact with, inhalation, and/or ingestion of lead at the Site and the threat of migration of lead at and from the Site. Exposure to the lead present at the Site by direct contact, incidental ingestion of contaminated media and ingestion of contaminated food items may present an unacceptable risk to ecological receptors (*i.e.*, impaired growth, compromised reproduction and reduced survival of organisms, such as invertivorous shore birds and herbivorous shore birds, which may incidentally ingest contaminated media). Lead in soil and sediment may pose a risk to aquatic receptors and terrestrial receptors present at the Site, such as the Semipalmated plover and the American robin. Exposure to the lead present at the Site by ingestion may cause a variety of adverse human health effects including severe damage to the brain and kidneys in adults and children and damage to the reproductive functions in adults.

10. In the late 1960s and/or early 1970s, Sea Land Development Corp., a now defunct corporation, used lead containing materials ("LCM"), and other materials to construct the Seawall.
11. In or about the late 1960s and early 1970s, one or more persons added LCM to the Western Jetty.
12. From approximately 1960 to approximately 1980, the Respondent owned and operated a lead smelting facility in Perth Amboy, N.J. (the "NL Facility").
13. The operations at the NL Facility entailed extracting lead from a variety of items, including scrap metal, dross and other LCM. These operations resulted in the generation of Waste Material containing LCM, such as furnace slag and hemispherical-shaped furnace mattes. The furnace mattes generated at the NL Facility contained lead at concentrations of approximately 6 to 8% lead by weight. The furnace slag generated at the NL Facility contained lead at concentrations of approximately 2 to 3% lead by weight.
14. From about 1969 to 1972, Respondent arranged with and/or permitted private contractors, including an entity named Liberty Trucking Company ("LTC"), to remove LCM, including furnace slag and furnace mattes from the NL Facility.
15. LTC transported LCM it received from the NL Facility to the real property which LTC or LTC's principal, Charles Ludwig, owned near Route 35 in Old Bridge Township and in Sayreville Borough. The property LTC owned in Old Bridge was in the Margaret's Creek Sector and was located immediately adjacent to the Seawall. The property LTC owned in Sayreville was located immediately adjacent to the Western Jetty.
16. In September 1972, an official of Madison Township (later renamed Old Bridge Township), wrote to NJDEP complaining of a lead slag land filling operation being conducted on the beach front on the Raritan Bay, in Madison Township. The official said that the land filling had passed the high tide mark and the dumping was taking place directly into the Raritan Bay. The official described the slag as large mound-shaped blocks of lead residue that were being dumped indiscriminately along the water line, making the beachfront unusable for recreation. The Madison official enclosed two photographs taken on September 16, 1972 of the slag waste at the Site. A Woodbridge News Tribune article reported the official saying that a later inspection of the area revealed that more slag had been dumped in that section of the beachfront. On October 16, 1972, the Madison official again wrote to the NJDEP and enclosed a photograph of what he alleged was "an actual dumping operation by Liberty Trucking Company."
17. LCM, including large hemisphere-shaped pieces of LCM, and lead battery casings, were found in and near the Seawall, in and near the Western Jetty and in and near the Margaret's Creek Sector.
18. The operations at the NL Facility generated large hemisphere-shaped pieces of LCM, lead battery casings and other LCM.

19. LTC removed various types of LCM from the NL Facility and transported that LCM to the Site and disposed of it at the Site.

20. The Seawall, the Western Jetty and the Margaret's Creek Sector contain LCM that was generated by the Respondent's operations at the NL Facility.

21. By letter dated February 9, 2012, EPA informed Respondent that EPA considered the Respondent to be a potentially responsible party for the Site.

IV. CONCLUSIONS OF LAW AND DETERMINATIONS

22. Lead is a hazardous substance under Section 101 of CERCLA, 42 U.S.C. § 9601.

23. The Site is a "facility" as defined in Section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

24. Respondent is a "person" as defined in Section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

25. Respondent is a responsible party under Section 107 (a)(3) of CERCLA, 42 U.S.C. § 9607(a)(3), for conditions at the Site and is subject to this Order under Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

26. Lead, LCM and other substances found in the Seawall, the Western Jetty, the Margaret's Creek Sector and in the soil and sediment at the Site are "hazardous substances" within the meaning of that term as defined in Section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

27. The presence of lead, LCM and other hazardous substances at the Site or the past, present or potential migration of lead, LCM and other hazardous substances currently located at or emanating from the Site, constitute actual and/or threatened "releases" as defined in Section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

28. The potential for further migration of hazardous substances from the Site, including lead, poses a "... threatened release of a hazardous substance from a facility" as that phrase is used in Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

29. Based upon the FINDINGS set forth above and in the documents found in EPA's administrative record for the Site, EPA has determined that the release and threatened release of lead, LCM and other hazardous substances into the environment at and from the Site may present an imminent and substantial endangerment to the public health or welfare or the environment within the meaning of Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

30. The response actions set forth in the ROD are required to prevent and/or mitigate any actual and/or potential threat of harm to human health or welfare or the environment caused by the release and threatened release of lead, LCM and other hazardous substances from the Site.

V. NOTICE TO THE STATE

31. Notice of this Order was given to the State of New Jersey Department of Environmental Protection on January 13, 2014 pursuant to Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

VI. ORDER

32. Based on the foregoing FINDINGS, CONCLUSIONS and DETERMINATIONS, Respondent is hereby ordered to comply with the following provisions, including but not limited to, all attachments, documents, schedules and deadlines in this Order, attached to this Order, or incorporated by reference into this Order.

VII. NOTICE OF INTENT TO COMPLY

33. Respondent shall provide, not later than 5 Days after the Effective Date, written notice to EPA's Remedial Project Manager ("RPM") and Assistant Regional Counsel for the Site at the address specified in Section XVII, stating whether Respondent will comply with the terms of this Order. If Respondent does not unequivocally commit to perform or finance the Work as provided by this Order, it shall be deemed to have violated this Order and to have failed or refused to comply with this Order. If applicable, Respondent's written notice shall describe, using facts that exist on or prior to the Effective Date, any "sufficient cause" defenses asserted by Respondent under Sections 106(b) and 107(c)(3) of CERCLA, 42 U.S.C. § 9606(b) and § 9607(c)(3). The absence of a response by EPA to the notice required by this Paragraph shall not be deemed to be acceptance of Respondent's assertions.

VIII. PARTY BOUND

34. This Order shall apply to and be binding upon the Respondent, its principals, officers, employees, agents, directors, subsidiaries, assigns and successors. Respondent is responsible for completing the Work and all applicable requirements of this Order. No change in the ownership, corporate status, or other control of the Respondent shall alter any of the Respondent's responsibilities under this Order.

35. Respondent shall provide a copy of this Order to any prospective owners or successors before a controlling interest in Respondent's assets, property rights, or stock are transferred to the prospective owner or successor. Respondent shall provide a copy of this Order to each contractor, subcontractor, laboratory, or consultant retained to perform any Work under this Order, within 5 Days after the Effective Date or on the date such services are retained, whichever date occurs later. Respondent shall also provide a copy of this Order to each person representing Respondent with respect to the Site or the Work and shall condition all contracts and subcontracts entered into hereunder upon performance of the Work in conformity with the terms of this Order. With regard to the activities undertaken pursuant to this Order, each contractor and subcontractor shall be deemed to be related by contract to the Respondent within the meaning of Section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3). Notwithstanding the terms

of any contract. Respondent is responsible for compliance with this Order and for ensuring that its contractors, subcontractors and agents comply with this Order, and perform any Work in accordance with this Order.

IX. WORK TO BE PERFORMED

36. The Work to be performed consists of all actions required in the ROD and the SOW.

37. The Work performed by Respondent pursuant to this Order shall, at a minimum, achieve the Performance Standards specified in the ROD. Notwithstanding any action by EPA, Respondent remains fully responsible for achievement of the Performance Standards in the ROD. Nothing in this Order, or in EPA's approval of any submission, shall be deemed to constitute a warranty or representation of any kind by EPA that full performance of the SOW will achieve the Performance Standards set forth in the ROD. Respondent's compliance with such approved documents does not foreclose EPA from seeking additional work to achieve the applicable Performance Standards.

38. Within 7 Days of the Effective Date, the Respondent shall commence all activities specified in the SOW in accordance with the time frames specified therein.

39. Selection of Supervising Contractor.

a. All aspects of the Work to be performed by Respondent pursuant to the Order shall meet any and all requirements of applicable federal, state and local laws and be performed under the direction and supervision of a Supervising Contractor, the selection of which shall be subject to disapproval by EPA. The Supervising Contractor shall be a qualified licensed professional engineering firm and must have a quality assurance system that complies with the Uniform Federal Policy for Implementing Quality Systems ("UFP-QS"), (EPA/505/F-03/001, March 2005). Within 21 Days after the Effective Date, Respondent shall notify EPA in writing of the name and qualifications of the proposed Supervising Contractor, including primary support entities and staff, proposed to be used in carrying out work under this Order and provide a copy of the contractor's quality management plan to demonstrate compliance with UFP-QS. EPA will issue a notice of disapproval or an authorization to proceed regarding hiring of the proposed contractor. If at any time thereafter, Respondent proposes to change a Supervising Contractor, Respondent shall give such notice to EPA and must obtain an authorization to proceed from EPA before the new Supervising Contractor performs, directs, or supervises any Work under this Order.

b. If EPA disapproves a proposed Supervising Contractor, EPA will notify Respondent in writing. Respondent shall submit to EPA a list of contractors, including the qualifications of each contractor that would be acceptable to them within 7 Days after receipt of EPA's disapproval of the contractor previously proposed. EPA will provide written notice of the names of any contractor(s) that it disapproves and an authorization to proceed with respect to any of the other contractors. Respondent may select any contractor from that list that is not disapproved and shall notify EPA of the name of the contractor selected within 7 Days of EPA's authorization to proceed.

40. Respondent shall notify EPA of the name and qualifications of any other contractor or subcontractor proposed to perform Work under this Order at least 10 Days prior to commencement of such Work.

41. EPA retains the right to disapprove of any, or all, of the contractors and/or subcontractors proposed by Respondent to conduct the Work. If EPA disapproves in writing of any of Respondent's proposed contractors to conduct the Work, Respondent shall propose a different contractor within 7 Days of receipt of EPA's disapproval.

42. All plans and specifications shall be prepared under the supervision of, and signed/certified by, a licensed New Jersey professional engineer.

43. Within 21 Days after the Effective Date, Respondent shall notify EPA, in writing, of the name and title of the proposed Project Coordinator, and alternate Project Coordinator, who may be employees of the Supervising Contractor. The Project Coordinator shall be responsible for the day to day management of all Work to be performed pursuant to the Order, knowledgeable at all times about all Work, and serve as the primary contact for EPA on all matters relating to the Work. The Project Coordinator should be available for EPA to contact during all working days. Respondent's Project Coordinator shall be subject to disapproval by EPA and shall have the technical expertise sufficient to adequately oversee all aspects of the Work. The Project Coordinator shall not be an attorney.

X. FAILURE TO ATTAIN PERFORMANCE STANDARDS

44. If, based on the results of the soil monitoring, EPA believes that one or more of the Performance Standards specified in the ROD will not be reached in a reasonable time period, EPA may require the Respondent to implement contingency measures. Such measures may require the submittal of a report assessing alternate remedial strategies and/or a plan that sets forth contingency measures.

XI. EPA PERIODIC REVIEW

45. Under Section 121 of CERCLA, 42 U.S.C. § 9621, and any applicable regulations, EPA may review the remedial action for the Site to assure that the Work performed pursuant to this Order adequately protects human health and the environment. Until such time as EPA certifies completion of the Work, Respondent shall conduct the requisite studies, investigations, or other response actions as determined necessary by EPA in order to permit EPA to conduct the review under Section 121 of CERCLA. As a result of any review performed under this Paragraph, Respondent may be required to perform additional response activities, or to modify Work previously performed.

XII. ADDITIONAL RESPONSE ACTIVITIES

46. EPA may determine that in addition to the Work identified in this Order and SOW, attached to this Order, additional response activities may be necessary to protect human health and the environment including meeting Performance Standards. If EPA determines that additional response activities are necessary, EPA may require Respondent to submit a work plan for additional response activities. EPA may also require Respondent to modify any plan, or other deliverable required by this Order, including any approved modifications.

47. Not later than 30 Days after receiving EPA's notice that additional response activities are required pursuant to this Section and request for a work plan, Respondent shall submit a work plan for the response activities to EPA for review and approval. Upon written approval by EPA, the work plan shall be incorporated into this Order as a requirement of this Order and shall be an enforceable part of this Order. Upon approval of the work plan by EPA, Respondent shall implement the work plan according to the standards, specifications, and schedule in the approved work plan. Respondent shall notify EPA of its intent to perform such additional response activities within 7 Days after receipt of EPA's notification of the need for additional response activities.

48. Any additional response activities that Respondent determines are necessary to protect human health and the environment shall be subject to written approval by EPA. If such additional response activities are authorized by EPA, then Respondent shall complete such response activities in accordance with plans, specifications, and schedules approved by EPA pursuant to this Order.

XIII. ENDANGERMENT AND EMERGENCY RESPONSE

49. If any action or occurrence during the performance of the Work, causes or threatens a release of Waste Material from the Site that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, the Respondent shall immediately take all appropriate action to prevent, abate, or minimize such release or threat of release and shall immediately notify the National Response Center at (800) 424-8802 and the appropriate EPA Remedial Project Manager. If the Remedial Project Manager is unavailable, the Respondent shall notify the Chief of the Mega Projects Section of the Emergency and Remedial Response Division of EPA Region 2 at (212) 637-4310 of the incident or Site conditions. The Respondent shall take such actions in consultation with EPA's Remedial Project Manager, or other available authorized EPA officer, and in accordance with all applicable provisions of this Order, including, but not limited to, the Health and Safety Plans, the Contingency Plans, and any other applicable plans or documents developed pursuant to the SOW.

50. The Respondent shall submit a written report to EPA within 7 Days after each such release or threatened release, setting forth the events that occurred and the measures taken, or to be taken, to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. Within 30 Days after the conclusion of such an event, Respondent shall submit a final report setting forth all actions taken in response thereto. This reporting requirement is in addition to, and not in lieu of, reporting under Section 103(c) of CERCLA, 42 U.S.C. §9603(c), and Section 304 of the Emergency Planning and Community

Right-To-Know Act of 1986, 42 U.S.C. §11004, et seq.

51. Nothing in the preceding Paragraphs or elsewhere in this Order shall be deemed to limit any authority of the United States to take, direct or order all appropriate action to protect human health and the environment or to prevent, abate or minimize an actual or threatened release of hazardous substances on, at or from the Site.

XIV. EPA REVIEW OF SUBMISSIONS

52. After review of any deliverable, plan, report or other item which is required to be submitted for review and approval pursuant to this Order, EPA may: (a) approve the submission; (b) approve the submission with modifications; (c) disapprove the submission and direct Respondent to re-submit the document after incorporating EPA's comments; or (d) disapprove the submission and assume responsibility for performing all or any part of the response action. As used in this Order, the terms "approval by EPA," "EPA approval," or a similar term means the action described in (a) or (b) above.

53. In the event of approval or approval with modifications by EPA, Respondent shall proceed to take any action required by the plan, report, or other item, as approved or modified by EPA.

54. Upon receipt of a notice of disapproval or a request for a modification, Respondent shall, within 14 Days or such longer time as specified by EPA in its notice of disapproval or request for modification, correct the deficiencies and resubmit the plan, report, or other item for approval. Notwithstanding the notice of disapproval, or approval with modifications, Respondent shall proceed, at the direction of EPA, to take any action required by any non-deficient portion of the submission.

55. If upon the first resubmission or upon any subsequent resubmission, the plan, report or other item is disapproved by EPA, Respondent shall be deemed to be out of compliance with this Order. In the event that a resubmitted plan, report or other item, or portion thereof, is disapproved by EPA, EPA may again require Respondent to correct the deficiencies, in accordance with the preceding Paragraphs of this Section. In addition, or in the alternative, EPA retains the right to amend or develop the plan, report or other item.

56. All plans, reports, and other submittals required to be submitted to EPA under this Order shall, upon approval by EPA, be deemed to be incorporated in and an enforceable part of this Order. In the event that EPA approves a portion of a plan, report, or other item required to be submitted to EPA under this Order, the approved portion shall be deemed to be incorporated in and as an enforceable part of this Order.

57. Respondent may request in writing that EPA approve modifications to EPA-approved reports, schedules, deliverables and other writings required under the terms of this Order at any time during the implementation of the Work required by this Order. Any and all such modifications under this Order must be approved in writing and signed by the Chief of the Special Projects Branch, Emergency and Remedial Response Division, EPA-Region 2.

- a. EPA shall have the sole authority to make any such modifications under this Order.
- b. EPA shall be the final arbiter in any dispute regarding the sufficiency or acceptability of all documents submitted and all activities performed pursuant to this Order. EPA may modify those documents and/or perform or require the performance of additional work unilaterally. EPA also may require Respondent to perform additional work unilaterally to accomplish the objectives set forth in this Order.

XV. PROGRESS REPORTS

58. In addition to the other deliverables set forth in this Order, Respondent shall provide written monthly progress reports to EPA with respect to actions and activities undertaken pursuant to this Order. The progress reports shall be submitted on or before the 15th day of each month following the Effective Date. Respondent's obligation to submit progress reports continues until EPA gives Respondent written notice under Paragraph 102.

XVI. COMPLIANCE WITH APPLICABLE LAWS

59. All activities carried out by Respondent pursuant to this Order shall be performed in accordance with the requirements of all federal and state laws and regulations. EPA has determined that the activities contemplated by this Order are consistent with the NCP.

60. Except as provided in Section 121(c) of CERCLA and the NCP, no permit shall be required for any portion of the Work conducted entirely on-Site. Where any portion of the Work requires a federal or state permit or approval, Respondent shall submit timely applications and take all other actions necessary to obtain and to comply with all such permits or approvals.

61. This Order is not, and shall not be construed to be, a permit issued pursuant to any federal or state statute or regulation.

XVII. REMEDIAL PROJECT MANAGER

62. All communications, whether written or oral, from Respondent to EPA shall be directed to EPA's Remedial Project Manager. Respondent shall submit to EPA and NJDEP copies of all documents, including plans, reports, and other correspondence, which are developed pursuant to this Order, and shall send these documents by certified mail or overnight mail to the following addresses:

3 Copies to:

Chief, Special Projects Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency

290 Broadway, 18th Floor
New York, New York 10007-1866
Attn: Raritan Bay Slag Superfund Site Remedial Project Manager

1 Copy (electronic) to:

New Jersey Superfund Branch
Office of Regional Counsel
U.S. Environmental Protection Agency
290 Broadway, 17th Floor
New York, New York 10007-1866
Attn: Site Attorney, Raritan Bay Slag Superfund Site

63. In the event that EPA requests more than the number of copies stated above of any report or other documents required by this Order for itself or the State, Respondent shall provide the number of copies requested. Upon request by EPA, Respondent shall submit in electronic form all or any portion of any deliverables Respondent is required to submit pursuant to the provisions of the Order.

64. EPA has the unreviewable right to change its Remedial Project Manager. If EPA changes its Remedial Project Manager, EPA will inform Respondent in writing of the name, address, and telephone number of the new Remedial Project Manager.

65. EPA's Remedial Project Manager shall have the authority lawfully vested in a Remedial Project Manager by the National Contingency Plan, 40 C.F.R. Part 300. EPA's Remedial Project Manager shall have authority, consistent with the National Contingency Plan, to halt any work required by this Order, and to take any necessary response action.

XVIII. ACCESS TO SITE NOT OWNED BY RESPONDENT

66. If the Site, the off-Site area that is to be used for access, property where documents required to be prepared or maintained by this Order are located, or other property subject to or affected by the remedial action, is owned in whole or in part by parties other than those bound by this Order, Respondent will obtain, or use its best efforts to obtain, site access agreements from the present owners within 60 Days of the Effective Date. Such agreements shall provide access for EPA, its contractors and oversight officials, the State and its contractors, and Respondent and Respondent's authorized representatives and contractors, and such agreements shall specify that Respondent is not EPA's representatives with respect to liability associated with the activities to be undertaken. Copies of such agreements shall be provided to EPA prior to Respondent's initiation of field activities. Respondent's best efforts shall include providing reasonable compensation to any property owner. If access agreements are not obtained within the time referenced above, Respondent shall immediately notify EPA of its failure to obtain access. Subject to the United States' non-reviewable discretion, EPA may use its legal authorities to obtain access for Respondent, may perform those response actions with EPA contractors at the property in question, or may terminate the Order if Respondent cannot obtain access agreements. If EPA performs those tasks or activities with contractors and does not terminate the Order,

Respondent shall perform all other activities not requiring access to that property. Respondent shall integrate the results of any such tasks undertaken by EPA into its reports and deliverables.

XIX. SITE ACCESS AND DATA/DOCUMENT AVAILABILITY

67. Respondent shall allow EPA and its authorized representatives and contractors to enter and freely move about all property at the Site and off-Site areas subject to or affected by the work under this Order or where documents required to be prepared or maintained by this Order are located, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, and contracts related to the Site or Respondent and its representatives or contractors pursuant to this Order; reviewing the progress of the Respondent in carrying out the terms of this Order; conducting tests as EPA or its authorized representatives or contractors deem necessary; using a camera, sound recording device or other documentary type equipment; and verifying the data submitted to EPA by Respondent. Respondent shall allow EPA and its authorized representatives to enter the Site, to inspect and copy all records, files, photographs, documents, sampling and monitoring data, and other writings related to work undertaken in carrying out this Order. Nothing herein shall be interpreted as limiting or affecting EPA's right of entry or inspection authority under federal law.

68. Respondent may assert a claim of business confidentiality covering part or all of the information submitted to EPA pursuant to the terms of this Order under 40 C.F.R. 2.203, provided such claim is not inconsistent with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7) or other provisions of law. This claim shall be asserted in the manner described by 40 C.F.R. 2.203(b) and substantiated by Respondent at the time the claim is made. Information determined to be confidential by EPA will be given the protection specified in 40 C.F.R. Part 2. If no such claim accompanies the information when it is submitted to EPA, it may be made available to the public by EPA or the State of New Jersey without further notice to Respondent. Respondent shall not assert confidentiality claims with respect to any data related to Site conditions, sampling, or monitoring.

69. Respondent shall maintain for the period during which this Order is in effect, an index of documents that Respondent claims contain confidential business information. The index shall contain, for each document, the date, author, addressee, and subject of the document. Upon written request from EPA, Respondent shall submit a copy of the index to EPA.

70. As requested by EPA, Respondent shall participate in the preparation of such information for distribution to the public and in public meetings which may be held or sponsored by EPA to explain activities at or relating to the Site.

XX. RECORD PRESERVATION

71. Respondent shall provide to EPA upon request, copies of all documents and information within its possession and/or control or that of its contractors or agents relating to activities at the Site or to the implementation of this Order, including but not limited to sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, sample traffic routing.

correspondence, or other documents or information related to the Work. Respondent shall also make available to EPA for purposes of investigation, information gathering, or testimony, its employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

72. Until 10 years after EPA provides notice pursuant to Paragraph 102 of this Order, Respondent shall preserve and retain all records and documents in its possession or control, including the documents in the possession or control of its contractors and agents on and after the Effective Date that relate in any manner to the Site. At the conclusion of this document retention period, Respondent shall notify the United States at least 90 Days prior to the destruction of any such records or documents, and upon request by the United States, Respondent shall deliver any such records or documents to EPA.

73. Within 90 Days after the Effective Date, Respondent shall submit a written certification to EPA's Remedial Project Manager and Site Attorney that it has not altered, mutilated, discarded, destroyed or otherwise disposed of any records, documents or other information relating to its potential liability with regard to the Site since notification of potential liability by the United States or the State.

XXI. DELAY IN PERFORMANCE

74. Any delay in performance of this Order that, in EPA's judgment, that is not properly justified by Respondent under the terms of this Section shall be considered a violation of this Order. Any delay in performance of this Order shall not affect Respondent's obligations to fully perform all obligations under the terms and conditions of this Order.

75. Respondent shall notify EPA of any delay or anticipated delay in performing any requirement of this Order. Such notification shall be made by telephone and electronic mail to EPA's Remedial Project Manager within 48 hours after Respondent first knew or should have known that a delay might occur. Respondent shall adopt all reasonable measures to avoid or minimize any such delay. Within 7 Days after notifying EPA by telephone and electronic mail, Respondent shall provide written notification fully describing the nature of the delay, any justification for delay, any reason why Respondent should not be held strictly accountable for failing to comply with any relevant requirements of this Order, the measures planned and taken to minimize the delay, and a schedule for implementing the measures that will be taken to mitigate the effect of the delay. Increased costs or expenses associated with implementation of the activities called for in this Order is not a justification for any delay in performance.

XXII. ASSURANCE OF ABILITY TO COMPLETE WORK

76. In order to ensure completion of the Work, Respondent shall secure financial assurance, initially in the amount of \$78,700,000 ("Estimated Cost of the Work"). The financial assurance must be one or more of the mechanisms listed below, in a form substantially identical to the sample documents available under "Financial Assurance" at <http://cfpub.epa.gov/compliance/resources/policies/cleanup/superfund/index.cfm>, and

satisfactory to EPA. Respondent may use multiple mechanisms if they are limited to trust funds, surety bonds guaranteeing payment, and/or letters of credit.

- a. A trust fund: (1) established to ensure that funds will be available as and when needed for performance of the Work in the event that Respondent fails to complete the Work required by this Order; (2) administered by a trustee that has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or state agency; and (3) governed by an agreement that requires the trustee to make payments from the fund only as the Emergency and Remedial Response Division Director directs in writing to either: (A) reimburse Respondent from the fund for expenditures made by Respondent for Work performed in accordance with this Order; (B) pay any other person who has performed or will perform the Work in accordance with this Order; or (C) refund Respondent any funds that are no longer necessary to perform the Work in accordance with this Order.
 - b. A surety bond, issued by a surety company among those listed as acceptable sureties on federal bonds as set forth in Circular 570 of the U.S. Department of the Treasury, guaranteeing payment and/or performance in accordance with Paragraph 80 (Access to Financial Assurance);
 - c. An irrevocable letter of credit, issued by an entity that has the authority to issue letters of credit and whose letter-of-credit operations are regulated and examined by a federal or state agency, guaranteeing payment in accordance with Paragraph 80 (Access to Financial Assurance);
 - d. A demonstration by Respondent that Respondent meets the financial test criteria and reporting requirements of 40 C.F.R. § 264.143(f) and this Section for the sum of the Estimated Cost of the Work and the amounts, if any, of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee; or
 - e. A guarantee to fund or perform the Work executed by one of the following: (1) a direct or indirect parent company of Respondent; or (2) a company that has a “substantial business relationship” (as defined in 40 C.F.R. § 264.141(h)) with Respondent; provided, however, that any company providing such a guarantee must demonstrate to EPA’s satisfaction that it meets the financial test criteria and reporting requirements for owners and operators set forth in subparagraphs (1) through (8) of 40 C.F.R. § 264.143(f) and this Section for the sum of the Estimated Cost of the Work and the amounts, if any, of other federal, state, or tribal environmental obligations financially assured through the use of a financial test or guarantee.
77. Within 90 Days after the Effective Date, Respondent shall submit all executed and/or otherwise finalized mechanisms or other documents required to the Remedial Project Manager.
78. If Respondent provides financial assurance including a demonstration or guarantee under

Paragraph 76.d or 76.e, the Respondent shall also comply, and shall ensure that its guarantor(s) comply, with the other relevant criteria and requirements of 40 C.F.R. § 264.143(f) regarding these mechanisms unless otherwise provided in this Section, including: (a) the initial submission to EPA of required financial reports and statements from the affected entity's chief financial officer ("CFO") and independent certified public accountant ("CPA") no later than 60 Days after the Effective Date; (b) the annual resubmission of such reports and statements within 90 Days after the close of each such entity's fiscal year; and (c) the notification of EPA no later than 30 Days after any such entity determines that it no longer satisfies the financial test criteria and requirements set forth at 40 C.F.R. § 264.143(f)(1). For purposes of this Section, references in 40 C.F.R. Part 264, Subpart H, to: (1) the terms "current closure cost estimate," "current post-closure cost estimate," and "current plugging and abandonment cost estimate" include the Estimated Cost of the Work; (2) "the sum of the current closure and post-closure cost estimates and the current plugging and abandonment cost estimates" mean the sum of all environmental obligations (including obligations under CERCLA, RCRA, and any other federal, state, or tribal environmental obligation) guaranteed by such company or for which such company is otherwise financially obligated in addition to the Estimated Cost of the Work under this Order; (3) the terms "owner" and "operator" include the Respondent making a demonstration or obtaining a guarantee under Paragraph 76.d or 76.e; and (4) the terms "facility" and "hazardous waste management facility" include the Site.

79. Respondent shall diligently monitor the adequacy of the financial assurance. If Respondent becomes aware of any information indicating that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, Respondent shall notify EPA of such information within 30 Days. If EPA determines that the financial assurance provided under this Section is inadequate or otherwise no longer satisfies the requirements of this Section, EPA will notify the Respondent of such determination. Respondent shall, within 30 Days after notifying EPA or receiving notice from EPA under this Paragraph, secure and submit to EPA for approval a proposal for a revised or alternative financial assurance mechanism that satisfies the requirements of this Section. Respondent shall follow the procedures of Paragraph 81 in seeking approval of, and submitting documentation for, the revised or alternative financial assurance mechanism. Respondent's inability to secure and submit to EPA financial assurance for completion of the Work shall in no way excuse performance of any other requirements of this Order, including, without limitation, the obligation of Respondent to complete the Work in accordance with the terms of this Order.

80. Access to Financial Assurance.

- a. In the event EPA determines that Respondent (a) has ceased implementation of any portion of the Work, (2) is seriously or repeatedly deficient or late in their performance of the Work, or (3) is implementing the Work in a manner that may cause an endangerment to human health or the environment, EPA may issue a written notice ("Performance Failure Notice") to both Respondent and the financial assurance provider regarding the affected Respondent's failure to perform. Any Performance Failure Notice issued by EPA will specify the grounds upon which such notice was issued and will provide Respondent a period of 10 Days within which to remedy the circumstances giving rise to EPA's issuance of such notice. If, after expiration of the 10 Day notice period specified

in this Paragraph, Respondent has not remedied to EPA's satisfaction the circumstances giving rise to EPA's issuance of the relevant Performance Failure Notice, EPA may at any time thereafter, draw fully on the funds guaranteed under the then-existing performance guarantee.

- b. If EPA is notified by the issuer of a financial assurance mechanism that it intends to cancel such mechanism, and the Respondent fails to provide an alternative financial assurance mechanism in accordance with this Section at least 30 Days prior to the cancellation date, the funds guaranteed under such mechanism must be paid prior to cancellation in accordance with Paragraph 80.a.
- c. EPA reserves the right to bring an action against Respondent under Section 107 of CERCLA for recovery of any costs incurred as a result of EPA's takeover of all or any portion(s) of the Work that are not paid for by financial assurance provided pursuant to this Section.

81. Modification of Amount, Form, or Terms of Financial Assurance. Respondent may submit, on any anniversary of the Effective Date or at any other time agreed to by the Parties, a request to reduce the amount, or change the form or terms, of the financial assurance mechanism. Any such request must be submitted to EPA in accordance with Paragraph 77, and must include an estimate of the cost of the remaining Work, an explanation of the bases for the cost calculation, and a description of the proposed changes, if any, to the form or terms of the financial assurance. EPA will notify Respondent of its decision to accept or reject a requested reduction or change pursuant to this Paragraph. Respondent may reduce the amount of the financial assurance mechanism only in accordance with EPA's approval. Within 30 Days after receipt of EPA's approval of the requested modifications pursuant to this Paragraph, Respondent shall submit to EPA documentation of the reduced, revised, or alternative financial assurance mechanism in accordance with Paragraph 77.

82. Release, Cancellation, or Discontinuation of Financial Assurance. Respondent may release, cancel, or discontinue any financial assurance provided under this Section only (a) if EPA issues a Certification of Completion of the Work; or (b) in accordance with EPA's approval of such release, cancellation, or discontinuation.

83. At least 7 Days prior to commencing any work at the Site pursuant to this Order, Respondent shall submit to EPA a certification that Respondent or its contractors and subcontractors have adequate insurance coverage or have indemnification for liabilities for injuries or damages to persons or property which may result from the activities to be conducted by or on behalf of Respondent pursuant to this Order. Respondent shall ensure that such insurance or indemnification is maintained for the duration of the Work required by this Order.

XXIII. UNITED STATES NOT LIABLE

84. The United States and EPA, by issuance of this Order, or by issuance of any approvals pursuant to this Order, assume no liability for any injuries or damages to persons or property resulting from acts or omissions by Respondent, or its directors, officers, employees, agents,

representatives, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order, or Respondent's failure to perform properly or complete the requirements of this Order. Neither the United States nor EPA may be deemed to be a party to any contract entered into by Respondent or its directors, officers, employees, agents, successors, assigns, contractors, or consultants in carrying out any action or activity pursuant to this Order, and Respondent shall not represent to anyone that the United States or EPA is or may be a party to any such contract.

85. Respondent shall save and hold harmless the United States and its officials, agents, employees, contractors, subcontractors, or representatives from any and all claims or causes of action or other costs incurred by the United States including but not limited to attorney fees and other expenses of litigation and settlement arising from or on account of acts or omissions of Respondent, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on behalf or under its control, in carrying out activities pursuant to this Order, including any claims arising from any designation of Respondent as EPA's authorized representatives under Section 104(c) of CERCLA.

XXIV. ENFORCEMENT AND RESERVATIONS

86. Nothing in this Order constitutes a satisfaction of or release from any claim or cause of action against Respondent or any person not a party to this Order, for any liability such person may have under CERCLA, other statutes, or common law, including but not limited to any claims of the United States under Sections 106 and 107 of CERCLA, 42 U.S.C. §§ 9606 and 9607.

87. Nothing in this Order shall be deemed to constitute preauthorization of a claim within the meaning of Section 111 of CERCLA, 42 U.S.C. § 9611, or C.F.R. § 300.700(d).

88. No action or decision by EPA pursuant to this Order shall give rise to any right to judicial review, except as set forth in Section 113(h) of CERCLA, 42 U.S.C. § 9613(h).

89. EPA reserves the right to bring an action against Respondent under Section 107 of CERCLA, 42 U.S.C. § 9607, for recovery of any response costs incurred by the United States related to this Order and/or for any other response costs which have been incurred or will be incurred by the United States relating to the Site. This reservation shall include, but not be limited to past costs, direct costs, indirect costs, the costs of oversight, the costs of compiling the cost documentation to support oversight cost demand, as well as accrued interest as provided in Section 107(a) of CERCLA.

90. Notwithstanding any other provision of this Order, at any time during the response action, EPA may perform its own studies, complete the response action (or any portion of the response action) as provided in CERCLA and the NCP, and seek reimbursement from Respondent for its costs, or seek any other appropriate relief.

91. Nothing in this Order shall preclude EPA from taking any additional enforcement actions, including modification of this Order or issuance of additional Orders, and/or additional

remedial or removal actions as EPA may deem necessary, or from requiring Respondent in the future to perform additional activities pursuant to CERCLA, 42 U.S.C. § 9606(a), *et seq.*, or any other applicable law. Respondent shall be liable under CERCLA Section 107(a), 42 U.S.C. § 9607(a), for the costs of any such additional actions.

92. Notwithstanding any provision of this Order, the United States hereby retains all of its information gathering, inspection and enforcement authorities and rights under CERCLA, RCRA, and any other applicable statutes or regulations.

93. Nothing in this Order shall constitute or be construed as a release from any claim, cause of action or demand in law or equity against any person for any liability it may have arising out of or relating in any way to the Site.

94. If a court issues an order that invalidates any provision of this Order or finds that Respondent has sufficient cause not to comply with one or more provisions of this Order, Respondent shall remain bound to comply with all provisions of this Order not invalidated by the court's order.

95. Except as specifically provided in this Order, nothing herein shall limit the power and authority of EPA or the United States to take, direct, or order all actions necessary to protect public health, welfare, or the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances, pollutants or contaminants, or hazardous or solid waste on, at, or from the Site. Further, nothing herein shall prevent EPA from seeking legal or equitable relief to enforce the terms of this Order, from taking other legal or equitable action as it deems appropriate and necessary, or from requiring the Respondent(s) in the future to perform additional activities pursuant to CERCLA or any other applicable law. EPA reserves the right to bring an action against Respondent(s) under section 107 of CERCLA, 42 U.S.C. Section 9607, for recovery of any response costs incurred by the United States related to this Order or the Site and not reimbursed by Respondent.

96. Notwithstanding any other provision of this Order, failure of Respondent to comply with any provision of this Order may subject Respondent to civil penalties of up to thirty-seven thousand five hundred dollars (\$37,500) per violation per Day, as provided in Section 106(b) (1) of CERCLA, 42 U.S.C. § 9606(b) (I), and the Debt Collection and Improvement Act of 1996 (see civil Monetary Penalty Inflation Adjustment Rule, 40 C.F.R. Part 19). Respondent also may be subject to punitive damages in an amount at least equal to but not more than three times the amount of any costs incurred by the United States as a result of such failure to comply with this Order, as provided in Section 107(c) (3) of CERCLA, 42 U.S.C. § 9607(c) (3). Should Respondent violate this Order or any portion thereof, EPA may carry out the required actions unilaterally, pursuant to Section 104 of CERCLA, 42 U.S.C. § 9604, and/or may seek judicial enforcement of this Order pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606. If EPA elects to take over the performance of all or any portion(s) of the Work pursuant to this provision, EPA shall have the right to enforce performance by the issuer of the relevant financial assurance mechanism and/or immediately access any financial assurance mechanisms provided pursuant to Section XXII (Assurance of Ability To Complete Work) of this Order.

XXV. ADMINISTRATIVE RECORD

97. Upon request by EPA, Respondent shall submit to EPA all documents related to the implementation of the Work for possible inclusion in the administrative record file.

XXVI. EFFECTIVE DATE AND COMPUTATION OF TIME

98. The Effective Date of this Order shall be 7 Days following the Day that this Order is signed by the Director, Emergency and Remedial Response Division, EPA Region 2, unless a conference is timely requested pursuant to Paragraph 99, below. If such conference is timely requested, the Effective Date of this Order shall be 3 Days following the date the conference is held, unless EPA otherwise modifies the Effective Date in writing. All times for performance of ordered activities shall be calculated from this Effective Date.

XXVII. OPPORTUNITY TO CONFER

99. Respondent may, before the Effective Date, request a conference with EPA to discuss this Order. If requested, the conference shall occur within 7 Days of Respondent's request for a conference.

100. The purpose and scope of the conference shall be limited to issues involving the implementation of the response actions required by this Order and the extent to which Respondent intends to comply with this Order. This conference is not an evidentiary hearing, and does not constitute a proceeding to challenge this Order. It does not give Respondent a right to seek review of this Order, or to seek resolution of potential liability, and no official stenographic record of the conference will be made. At any conference held pursuant to Respondent's request, Respondent may appear in person or by an attorney or other representative.

101. Requests for a conference must be by telephone followed by written confirmation sent by overnight mail and electronic mail that Day to:

Frank X. Cardiello
Assistant Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency
290 Broadway, 17th Floor
New York, N.Y. 10007-1866
Telephone: (212) 637-3148
cardiello.frank@epa.gov

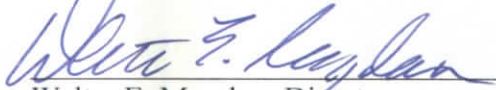
XXVIII. TERMINATION AND SATISFACTION

102. This Order may be terminated by EPA if Respondent demonstrates in writing and

certifies to the satisfaction of EPA that all Work and activities required under this Order, including any additional work required by EPA, have been performed fully in accordance with this Order and EPA concurs in writing with the certification. Such an approval by EPA, however, shall not relieve Respondent of any remaining obligations under the Order, including those requirements set forth in Section XX regarding record preservation, or applicable law.

So Ordered, this 30th Day of January, 2014.

By:



Walter E. Mugdan, Director
Emergency and Remedial Response Division
U.S. Environmental Protection Agency-Region 2



UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

REGION 2

RECORD OF DECISION

RARITAN BAY SLAG SUPERFUND SITE
Townships of Old Bridge/Sayreville, New Jersey

CERCLIS ID NJN000206276

May 2013

PART 1: DECLARATION

1.0 SITE NAME AND LOCATION

Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, Middlesex County, New Jersey
EPA CERCLIS ID #NJN000206276

2.0 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Raritan Bay Slag site (site) in Old Bridge and Sayreville, Middlesex County, New Jersey. This is the final remedy for the Site. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. § 9601 et seq, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300, as amended.

This decision is based on the Administrative Record for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 U.S.C. § 9613(k). This Administrative Record file is available for review online at <http://www.epa.gov/region2/superfund/npl/raritanbayslag/>; at the EPA Region 2 Records Center 290 Broadway, 18th Floor New York, New York 10007-1866, at the Old Bridge Central Library, 1 Old Bridge Plaza, Municipal Center, Old Bridge, NJ 08857; and at the Sayreville Library, 1050 Washington Rd., Parlin, NJ 08859. The Administrative Record Index (Appendix E) identifies each of the items comprising the Administrative Record upon which the selection of the Remedial Actions is based.

The state of New Jersey concurs with the Selected Remedy (See Appendix F).

3.0 ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

4.0 DESCRIPTION OF SELECTED REMEDY

The response action described in this document represents the first and only planned remedial phase or operable unit for the Site. In March 2012, the Region 2 office of the EPA discussed the proposed alternatives for site remediation with EPA's National Remedy Review Board (NRRB). The Selected Remedy described in this ROD was selected based upon NRRB input.

The Selected Remedy addresses the potential risks to human health and the environment associated with the Site. The Selected Remedy includes the following components:

- Remediation of Slag, Battery Casings and Associated Wastes Principal threat waste (PTW) such as slag, battery casings and associated wastes will be excavated based on visual observation and disposed of at appropriate off-site facilities. Slag materials that are not readily visible will be remediated as soil/sediment. Demolition debris in the form of concrete and various bricks will also be removed and disposed of at appropriate off-site facilities.
- Surface Water By removing PTW, surface water contamination will be reduced to acceptable levels over time. Monitoring will be implemented to ensure the effectiveness of the remedy by achieving the remedial goals presented in Table 5-2.
- Soil and Sediments Contaminated soils and sediment above the lead remediation cleanup level of 400 mg/kg will be excavated and/or dredged and disposed of at appropriate off-site facilities.

5.0 STATUTORY DETERMINATIONS

Part 1: Statutory Requirements

The Selected Remedy meets the mandates of CERCLA § 121 and the regulatory requirements of the NCP. This remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate requirements (ARARs) to the remedial action, is cost-effective and utilizes permanent solutions to the maximum extent practicable.

Part 2: Statutory Preference for Treatment as a Principal Element

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility or volume of hazardous substances, pollutants or contaminants as a principal element through treatment).

Part 3: Five-Year Review Requirements

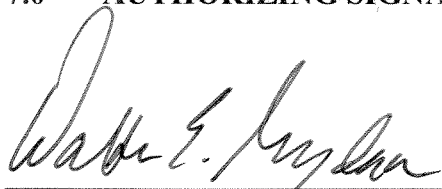
Since this remedy will not result in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, five-year reviews are not required. However, after the completion of construction, a policy review to ensure that the remedy is, or will be, protective of human health and the environment may be conducted if remedial goals are not achieved within five years.

6.0 ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations. (Part 2: Decision Summary Section 7.1 and 7.2)
- Baseline risk represented by the chemicals of concern. (Part 2: Decision Summary Section 7.1 and 7.2)
- Cleanup levels established for chemicals of concern and the basis for these levels. (Part 2: Decision Summary Section 12.4)
- How source materials constituting principal threats are addressed. (Part 2: Decision Summary Section 12.1)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD. (Part 2: Decision Summary Section 6.0)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy. (Part 2: Decision Summary Section 12.4)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate and the number of years over which the remedy cost estimates are projected. (Part 2: Decision Summary Section 12.3)
- Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision). (Part 2: Decision Summary Section 12.0)

7.0 AUTHORIZING SIGNATURE



Walter E. Mugdan, Director
Emergency and Remedial Response Division
Environmental Protection Agency, Region 2

May 23, 2013

Date



UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

REGION 2

RECORD OF DECISION
Decision Summary

RARITAN BAY SLAG SUPERFUND SITE
Townships of Old Bridge/Sayreville, New Jersey

CERCLIS ID NJN000206276

May 2013

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PART 2: DECISION SUMMARY

1.0 SITE NAME, LOCATION AND BRIEF DESCRIPTION

The Raritan Bay Slag Superfund site (site) is located in a recreation area on the shore of Raritan Bay, in the eastern part of Old Bridge Township within the Laurence Harbor section in Middlesex County, New Jersey. A small portion of the western end of the site, the Western Jetty at the Cheesequake Creek Inlet, is located in the Borough of Sayreville. The site is bordered to the north by Raritan Bay and to the east, west and south by residential properties (Figure 1-1). Slag, battery casings and associated wastes (i.e., demolition debris in the form of concrete and a variety of bricks, including fire bricks), contaminated soils and sediments were identified at the site. Lead is the primary contaminant of concern at the site.

The National Superfund Database Identification Number for the site is NJN000206276. The EPA, as the lead agency, has provided funding for all removal and investigating to date, although a potentially responsible party (PRP) has been identified.

The Raritan Bay Slag site is a recreational area and has been divided into three sectors with 11 site areas based on areas identified in historical investigations, site physical characteristics and the locations of known or potential sources:

- Seawall Sector (Areas 1, 2, 3, 4, 5 and 6)
- Jetty Sector (Areas 7, 8 and 11)
- Margaret's Creek Sector (Area 9)

Discussions are organized into three sectors based on the type of environment and proximity to source areas; sectors include the Seawall Sector, where slag was deposited and used to reinforce the seawall; the Jetty Sector, which consists of a jetty encapsulated with slag; and the Margaret's Creek Sector comprised of a wetlands portion and an upland portion. Area 10, a non-impacted area located to the east of the site, was used to collect background samples.

In the Jetty and Seawall Sectors, the term "soil" refers to all contaminated solids other than slag and battery casings and associated wastes that lie upland of the mean high tide line. The term "sediment" in the Jetty and Seawall Sectors refers to all contaminated solids other than slag and battery casings and associated wastes seaward of the mean high tide line. The terms "shallow" and "deeper" for soil and sediment refer to 0 to 2 feet below ground surface (bgs) and greater than 2 feet bgs, respectively. In the Margaret's Creek Sector, the term "sediment" refers to solids that are submerged in water, and the term "soil" refers to solids other than the slag and battery casings and associated wastes that are on dry land.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The initial activities that led to the site's National Priorities List (NPL) listing began in the late 1960's and early 1970's, when slag, mostly in the form of blast furnace pot bottoms from a secondary lead smelter, was used in the construction of a seawall in an area that had sustained significant beach erosion and damage due to a series of storms in the 1960's. Demolition debris in the form of concrete and a variety of bricks, including fire bricks, was also placed along the beachfront. A portion of the seawall also contains large riprap believed to have been placed over the slag when the grassed and paved portion of the park was developed.

The Western Jetty at Cheesquake Creek Inlet is part of a federally authorized navigation project by the United States Army Corps of Engineers (USACE) and has been in existence since the USACE constructed it in the late nineteenth century. Slag was reportedly placed on the jetty during the same general time period as the construction of the seawall. Most of the jetty is covered with slag that is similar in appearance to slag on the seawall. The slag was placed on the jetty and used as fill/stabilizing material for the seawall. Sea Land Development Corp., the owner of the property on which the seawall was built, used the lead slag, for the seawall construction.

Elevated levels of lead, antimony, arsenic, chromium and copper were identified by the New Jersey Department of Environmental Protection (NJDEP) in the soil along the seawall in 2007 and at the edge of the beach near the western end of the seawall. Old Bridge Township placed a temporary "snow" fence in this area, posted "Keep-off" signs in the park along the split rail fence that borders the edge of the seawall, and notified the residents of Laurence Harbor.

On April 24, 2008, EPA received a request from NJDEP to evaluate the Laurence Harbor seawall for a removal action under the CERCLA. EPA collected samples at the site in September 2008 as part of an Integrated Assessment. The purpose of this sampling event was to determine whether further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) was needed. On November 3, 2008, NJDEP forwarded an amended request to include the Western Jetty along the Cheesquake Creek Inlet as part of the overall site. As a result, sampling included the collection of soil, sediment, water, biological and slag samples from along the seawall in Laurence Harbor, the Western Jetty at the Cheesquake Creek Inlet, the beaches near these two locations and the developed portion of the park. EPA and NJDEP analytical results determined that significantly elevated levels of lead and other heavy metals are present in the soils, sediment and surface water in and around both the seawall in Laurence Harbor and the Western Jetty at the Cheesquake Creek Inlet.

At EPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the seawall in Laurence Harbor, the beach between the western end of the seawall and the first jetty, and the Western Jetty at the Cheesquake Creek Inlet, including the waterfront area immediately west of the inlet (ATSDR 2009). As a result of this determination, EPA conducted a removal action to restrict access to these areas (by installing

permanent fences and posting signs) and provided public outreach to inform residents and those using these areas of the health hazard that exists.

In March 2009, the 47-acre property associated with Margaret's Creek was also included in the overall site. The "Proposed Rule" proposing the site to the NPL was published in the *Federal Register* on April 9, 2009. The "Final Rule" adding the Site to the NPL was published in the *Federal Register* on November 4, 2009.

2.1 Summary of Previous Federal, State, and Local Investigations

A detailed summary of the data and reports completed before the RI is provided in the Final (Revised) Data Gap Evaluation Technical Memorandum (CDM Smith 2010). Reports produced for EPA, NJDEP and Old Bridge Municipal Utility Authority (OBMUA) were reviewed. The reports consisted of site investigations, ecological risk assessments, a geophysical survey, a remedial action work plan and report, and the Hazard Ranking System (HRS) documentation record.

A brief summary of the investigations and results is presented below.

- NJDEP conducted a preliminary site investigation in March 2007 followed by two subsequent sampling events in May 2007 and July 2007. The investigations consisted of 11 test pits to inspect the fill material visually and three rounds of soil sampling, totaling 83 samples, analyzed by an off-site analytical laboratory. The analytical sample results revealed elevated levels of lead, antimony and arsenic.
- OBMUA conducted an investigation in May 2007 which consisted of 43 surface (0 to 6 inches) soil samples, 23 borings and 3 shallow monitoring wells. The surface soil samples were screened for metals in the field using a portable X-Ray Fluorescence (XRF) analyzer. Eight samples from the soil borings and the three groundwater samples were sent off-site for analysis. The analytical sample results for soils revealed elevated levels of lead, antimony, chromium and arsenic. Groundwater samples exceeded screening criteria for nine metals; however, lead did not exceed screening levels.

Between November 2007 and February 2008, OBMUA conducted a remedial action within the sanitary sewer construction easement in order to manage the contaminated soil prior to construction. These activities were within the upland road area that traverses the Margaret's Creek wetland from Route 35 to the beach. Soil was excavated to a depth of 6 to 18 inches below grade and classified as hazardous, as it failed the test for toxicity characteristic leaching procedure (TCLP) for lead. A total of 1,075 tons of hazardous soil were disposed of off-site. Thirty-five post excavation soil samples were collected to confirm the effectiveness of the removal.

EPA conducted several investigations and a risk assessment, as summarized below.

- A Phase I Investigation conducted in September 2008, included: 48 surface water samples from Areas 1, 2, 4, 6, 7, 8 and 9; 84 sediment samples from Areas 1, 2, 6, 8, 9 and 10 (background location); 95 surface soil samples from Areas 1, 2, 3, 5, 6, 7, 8 and 10 (background location); and ten subsurface soil samples from Areas 1, 2, 5 and 8.
- A chemical assessment investigation conducted in September 2008, included: 17 slag samples from Areas 1 and 8; 11 beach sediment samples from Area 1; 5 pore water samples from Area 1; and 24 samples from five types of biota from Area 1. Analytical results from this sampling event were also used in the ecological risk assessment for Area 1.
- A Phase II Investigation conducted in April 2009, included: 134 surface and near-surface soil samples, 116 sediment samples and 34 surface water samples. Sediment, soil and surface water samples were collected from Areas 5, 6 and 9. Near-surface soil samples were collected from Areas 5 and 6. Sediment samples were also collected from Area 10 (background location).
- EPA conducted additional sediment sampling in June and July 2009. A total of 354 sediment samples were collected from Areas 1, 2, 5, 6, 7 and 8.

The following activities have also been conducted at the site.

- EPA conducted an aerial photography review for the years 1957 to 2008.
- OBMUA conducted Phase IA and Phase IB Cultural Resources Surveys for the Laurence Harbor Interceptor Line in the Margaret's Creek Sector.
- OBMUA conducted a geotechnical investigation in Area 9 which included soil borings and cone penetration tests.
- OBMUA conducted a hydrogeologic investigation which included slug test analyses and pump test analyses at three monitoring wells, MW-1 through MW-3, in Area 9.
- ATSDR evaluated the existing data and provided recommendations on use restrictions for specific site areas.
- EPA conducted a side-scan sonar investigation in specific areas of the site to examine the morphology of the sediment in Cheesequake Creek and surrounding areas.
- EPA conducted a geophysical survey in portions of Old Bridge Waterfront Park and from Laurence Parkway to Margaret's Creek to identify the presence of buried materials, including slag. The report identified subsurface anomalies and recommended areas for further investigation.

- EPA conducted a preliminary ecological risk assessment to assess the impact of metals being released and transported from the slag boulders and debris to the biological communities inhabiting and/or utilizing the intertidal zone adjacent to the seawall.

2.2 Summary of Remedial Investigation

RI field activities were conducted from September 2010 through June 2011. Activities focused on collecting sufficient data to supplement the existing data as identified in the Final (Revised) Data Gap Evaluation Technical Memorandum (CDM Smith 2010). The major elements of the field investigation are outlined below.

Field Investigation Survey and Study Activities Included:

- Topographic and bathymetric surveys were conducted to provide information on the geometry and physical features of the Raritan Bay floor, beaches and upland areas, including the surrounding residential communities. The data were used to develop a geographic information system (GIS) and to delineate the upland and intertidal zones.
- Hydrodynamics and sediment dynamics studies were conducted to provide data on currents and sediment transport in the nearshore environment of Raritan Bay.
- A slag distribution study and a slag survey were conducted to define the distribution of slag at the site. The slag distribution study included test excavations to identify the buried slag in the vicinity of the seawall. The slag survey was conducted to identify and estimate the volume of slag and battery casings at the seawall, beachfront areas, Western Jetty and Margaret's Creek area.
- Exchange studies were conducted in the Cheesequake Creek inlet and Margaret's Creek to estimate the exchange (flux) of contaminants between the creeks and the bay.
- A hydrogeologic assessment was conducted to provide the data to evaluate geologic and hydrogeologic conditions at the site. The hydrogeologic assessment activities are outlined below.
 - Stratigraphic Borings - Two initial borings were advanced to assess site stratigraphy prior to drilling monitoring wells.
 - Monitoring Wells - A total of 15 shallow and six deep wells were installed in the overburden to determine the groundwater flow direction, horizontal and vertical hydraulic gradients and establish baseline groundwater quality.
 - Groundwater and Surface Water Interaction - Continuous water level measurements were recorded in 15 monitoring wells for a period of one month (one tidal cycle). To document long-term changes in groundwater elevations, six

rounds of synoptic water level measurements were taken from February to June 2011.

- A Stage IA cultural resources survey was conducted to identify any cultural or archeological resources within the study area. The survey excluded areas of Margaret's Creek where previous Stage 1A and Stage 1B cultural resources surveys were conducted by OBMUA.
- An ecological characterization survey was conducted to characterize habitats in the study area and to identify threatened and endangered species. The survey covered the uplands, beaches and near-shore environment of Raritan Bay.

Sampling Activities Included:

Sample depths and sample analyses varied depending on the sample locations and purpose. The environmental samples collected during the field investigation are summarized below.

The Seawall Sector (Areas 1, 2, 3, 4, 5 and 6) samples were collected from upland, beach and tidal areas potentially impacted by slag material in and around the seawall. A total of 291 sediment samples, 219 soil samples and 37 surface water samples were collected from the Seawall Sector.

The Jetty Sector (Areas 7, 8 and 11) samples were collected from upland, beach and tidal areas potentially impacted by slag material in and around the western Cheesequake Creek Inlet Jetty. A total of 165 sediment samples, 52 soil samples and 25 surface water samples were collected from the Jetty Sector.

The Margaret's Creek Sector (Area 9) samples were collected from upland, beach and wetland areas potentially impacted by fill material. A total of 184 sediment samples, 276 soil samples and 21 surface water samples were collected from the Margaret's Creek Sector.

One round of groundwater samples was collected from 21 monitoring wells installed during the field investigation. On April 6, 2011, two additional samples were collected from wells MW-10S and MW-10D to confirm previous lead analysis results.

Biological samples included blue crab, hard clams, ribbed mussels, killifish, long neck clams, sea lettuce and six species of game fish across the site.

Forty soil samples were collected from Areas 2, 3, 5, 6 and 9 for in-vitro bioavailability and electron microprobe analysis for lead and arsenic.

Test excavation activities were conducted between April 21 and May 5, 2010. A total of 45 soil samples were collected from the park area of the Seawall Sector and 26 test excavations were advanced with an excavator. Test excavations were advanced along 12 transects oriented approximately perpendicular to the shoreline and seawall. The test excavation length and width

varied from location to location. Excavations were extended to the water table or to a depth of 10 feet bgs, whichever was encountered first.

EPA's Lead Technical Review Workgroup (TRW) has specific guidance on lead sampling. Composite soil samples were collected according to TRW guidance from 203 locations above the spring low tide line and analyzed for lead. Each composite consisted of five subsamples collected within a 50-foot radius of a center point at a depth of 0 - 2 inches to be representative of soil that is likely to be ingested.

Sediment, surface water, soil and groundwater samples were collected to develop site-specific background concentrations. Forty-nine background sediment, 25 background soil samples and 11 background TRW samples were collected from Area 10. Twelve background surface water samples were collected from Raritan Bay. Background groundwater samples were collected from monitoring well MW-11S, located upgradient of the site wells.

2.3 Enforcement

In 2012, EPA informed NL Industries, Inc. (NL) that it was a PRP for the site. Although EPA did not ask NL to enter into an administrative agreement to perform any investigation(s) or cleanup(s) for the site, NL engaged a contractor to perform an engineering evaluation/cost analysis to assess whether certain response actions were appropriate. NL also provided EPA with comments on the Final Remedial Investigation Report and the Revised Final Feasibility Study Report which were prepared by EPA. EPA will continue its efforts to determine if any additional PRPs exist for the Site.

3.0 COMMUNITY PARTICIPATION

EPA has participated in a number of informational and public meetings to engage the local community and distributed fact sheets to update the community on EPA's activities. A Community Advisory Group (CAG) was formed with the assistance of EPA in 2010. The CAG includes members of the local community, residents directly impacted by the site, local public and environmental interest groups, local government units and local businesses. A Technical Assistance Service to Communities (TASC) grant was provided to the CAG to assist with its needs and concerns about the hazardous waste cleanup process, document interpretation and other environmental problems relating to the site. These community participation activities meet the public participation requirements in CERCLA § 121 and the NCP Section § 300.430(f) (3).

Availability sessions were also conducted during the monthly CAG meetings to provide an opportunity for the community to speak to EPA in a relatively informal setting and learn about activities being conducted at the site. Meetings were also held to provide updates on the progress of the Remedial Investigation and Feasibility Study (RI/FS) and sampling activities following major storm events.

EPA met with the Mayor and officials of Old Bridge and Sayreville on several occasions to discuss the site and future land use. These officials conveyed that all areas impacted by the site will remain and/or return to recreational use once the site has been remediated.

The Proposed Plan for the site was released for public comment on September 28, 2012. The Proposed Plan and other site-related documents were made available to the public in the administrative record file maintained at the Old Bridge Central Library, 1 Old Bridge Plaza Municipal Center, Old Bridge, NJ 08857; the Sayreville Library, 1050 Washington Road, Parlin, NJ 08859; and at the EPA Region 2 Records Center located at 290 Broadway, New York, New York 10007. The notice of availability of these documents was published in the Middlesex County *Home News Tribune* on September 28, 2012 (Figure 3-1). A public comment period was held from September 28, 2012 through October 29, 2012. An extension to the public comment period was requested. As a result, it was extended to November 27, 2012.

A public meeting was held on October 17, 2012 at the George Bush Senior Center 1 Old Bridge Plaza, Old Bridge, NJ 08857 to discuss the findings of the RI/FS and to present EPA's Proposed Plan to a broader community audience than those that had already been involved at the site. At this meeting, EPA representatives answered questions about the remedial alternatives developed as part of the RI/FS. EPA's response to the comments from the public meeting and the public comment period are included in the Responsiveness Summary, which is part of this Record of Decision.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

For the purposes of planning response actions, EPA will address the site in a single remedial phase or Operable Unit (OU). This ROD addresses the slag, battery casings and associated wastes, contaminated soils and sediments above the remediation cleanup levels of 400 mg/kg for lead at the site. This action is considered the final remedy for slag, battery casings and associated wastes, contaminated surface water, soils and sediments at the site.

The Selected Remedy is the final remedy and will not result in contaminants remaining on the site above cleanup levels that allow for unrestricted use. In addition, the Selected Remedy described herein does not require five-year reviews, institutional controls, long-term monitoring or continued maintenance of security measures at the site. However, after the completion of construction, a policy review to ensure that the remedy is, or will be, protective of human health and the environment may be conducted if remedial goals are not achieved within five years.

5.0 SITE CHARACTERISTICS

The site is approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the area just beyond the Western Jetty at the Cheesequake Creek Inlet on the shore of Raritan Bay. The portion of the site in Laurence Harbor is part of the Old Bridge Waterfront Park. The park includes walking paths, a playground area, several public beaches and

three jetties, not including the two jetties (Western Jetty and Eastern Jetty) at the Cheesequake Creek Inlet. The park waterfront is protected by a seawall, which is partially constructed with pieces of waste slag from a secondary lead smelter. The Western Jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty are located in Sayreville. Slag has been placed on top of the Western Jetty and is observed along the adjoining waterfront. Slag was also observed in the Margaret's Creek area, an undeveloped 47-acre wetland located southeast of the seawall in Laurence Harbor.

The site topography is characterized by a gradual rise along the beach to shore bluffs. The bluffs extend the length of the site along the bay except for Area 9, in front of the Margaret's Creek wetlands. The elevation at the top of the shore bluffs is about 30 feet above mean sea level. South of the bluffs, the terrain is primarily flat.

The Raritan Bay bathymetry near the beach is characterized by a very gradual seaward slope. A significant ebb shoal (shallow depositional area) has built up near the mouth of Cheesequake Creek. North of this ebb shoal, the depth increases sharply.

Surface water drainage in the vicinity of the site is toward tidal creeks, the bay and their associated wetlands. The major surface water bodies at the site include Raritan Bay, Cheesequake Creek and Margaret's Creek. These water bodies are subject to tidal fluctuations averaging 5.5 feet. Because the slope of the Raritan Bay floor is very gentle, 400 to 600 feet of the bay floor are exposed during low spring tide.

The entire site, except for small portions of the upland areas in Margaret's Creek Sector, is within zones of high or moderate flooding. Wetlands at the site are all subtidal or intertidal estuarine habitats. The wetlands of Margaret's Creek are a mixture of unconsolidated shore with organic soil and emergent wetlands that are vegetated and partially flooded.

The beach areas are sandy with little organic carbon. Upland of the beaches, soils are more organic-rich and contain a higher proportion of silt and clays. The subtidal and intertidal areas along Raritan Bay are predominantly sandy, with little silt, clay or organic carbon.

In Raritan Bay, wave-driven and tidal currents transport sediment. Storms can increase the quantity of sediment currents transport by up to a factor of four (Woods Hole Group [WHG], 2011). Across most of the shoreline, non-cohesive sand on beaches and on the Bay floor is readily mobilized into currents. The seawall and revetment (Area 6) limit sand supply.

Since the bay shoreline is relatively quiet and protected from ocean swells, significant waves and mixing occur only during storm events. Wave-induced mixing is expected to be prominent on beaches and could result in contamination being present at depth on beaches. Cohesive sediments and lower-energy environments are present in the lee (western side) of the Cheesequake Creek Western Jetty, limiting sediment erosion and mixing.

Jetties along Raritan Bay affect sediment transport. The lee side of the Cheesequake Creek Western Jetty is a very low energy environment protected from waves and storms. Depositional areas are present just off the eastern Cheesequake Creek jetty. A depositional shoal is also

present offshore of the mouth of Margaret's Creek. A dynamic mixing zone is present just offshore of the Cheesequake Creek Western Jetty with irregular accumulation and sediment is rearranged frequently. Geochronology studies, designed to assess the rate of deposition, were conducted in the Margaret's Creek wetlands because it is relatively protected from the wind and waves that would disturb sediment stratigraphy. Geochronology cores were not collected offshore because it is a dynamic wave-influenced area with no undisturbed sediment. Data show that sediment deposition is actively occurring across the open water portions of the wetlands.

5.1 Geology and Hydrology

The site is located in the Coastal Plain Physiographic Province of New Jersey, a seaward-sloping wedge of unconsolidated sediments ranging in age from Cretaceous to Holocene. The coastal plain sediments are composed of clay, sand, silt and gravel, and are overlain by Quaternary age deposits. In the vicinity of the site, the Quaternary deposits are underlain by the Upper Cretaceous age Magothy and Raritan Formations which are, in turn, underlain by the Lower Cretaceous age Potomac Group.

The site is located within the Raritan River Basin. This Basin is bounded by the Passaic River Basin to the north, Delaware River Basin to the west and Atlantic Coastal Basin to the south. The major aquifer system in this region is the New Jersey Coastal Plain Aquifer System.

Since Raritan Bay is relatively calm during normal conditions, the majority of sediment movement occurs during storms. Waves in the Bay originate predominantly from the east and northeast (Atlantic Ocean). Thus, contaminants from the seawall and the Margaret's Creek area tend to migrate westward toward the Western Jetty. Currents near the Cheesequake Creek Inlet and Western Jetty are complex due to the strong dominant tidal currents within Cheesequake Creek. Per tidal cycle, more water and sediment exit Cheesequake Creek than enter. In Margaret's Creek, the regular flow of water through the wetlands produces minimal currents, although storm surges could produce stronger currents.

Groundwater and surface water interaction at the site were evaluated by collecting a series of synoptic water level measurements from all monitoring wells and staff gauges. Continuous water level data from selected monitoring wells were also collected.

At the western end of the seawall, under low tide conditions, groundwater flow is toward the Bay. Under high tide conditions, the overall groundwater flow direction is also toward the Bay, but the flow is more complex due to the influence of tides and the vertical gradient. Flow in the deeper zone tends to stagnate on the inland side of the seawall while shallow groundwater flow is still toward the Bay. The eastern end of the seawall at low and high tide shows a simpler relationship between groundwater elevation and tidal elevation; lateral groundwater flow at low tide is toward the Bay while at high tide, lateral groundwater flow is inland.

Near the foot of the Cheesequake Creek Western Jetty, the deep and shallow water levels were essentially the same. They both fluctuated about six feet in response to tidal changes in the channel on one side and beach on the other side.

In the Margaret's Creek area about 250 feet to 1,200 feet inland from the Bay, no significant tidal influence was noted. However, the difference in water level elevation along this section is about four feet. This observation indicates that there is a consistent component of shallow groundwater flow toward the Bay in this area.

5.2 Sampling Strategy

RI field activities were conducted from September 2010 through June 2011. Activities focused on collecting sufficient data to supplement the existing data as identified in the Final (Revised) Data Gap Evaluation Technical Memorandum (CDM Smith 2010). The major elements of the field investigation are outlined below.

Topographic and bathymetric surveys were conducted to provide information on the geometry and physical features of the Raritan Bay floor, beaches and upland areas, including the surrounding residential communities. The data were used to delineate the upland and intertidal zones.

- Hydrodynamics and sediment dynamics studies were conducted to provide data on currents and sediment transport in the near-shore environment of Raritan Bay.
- A slag distribution study and a slag survey were conducted to define the distribution of slag at the site. The slag distribution study included test excavations to identify the buried slag in the vicinity of the seawall. The slag survey was conducted to identify and estimate the volume of slag and battery casings at the seawall, beachfront areas, Western Jetty and Margaret's Creek area.
- Exchange studies were conducted in the Cheesequake Creek Inlet and Margaret's Creek to estimate the exchange (flux) of contaminants between the creeks and the bay.
- A hydrogeologic assessment was conducted to provide the data to evaluate geologic and hydrogeologic conditions at the site and included:
 - Monitoring Wells – A total of 15 shallow and six deep wells were installed in the overburden to determine the groundwater flow direction, horizontal and vertical hydraulic gradients, tidal effects and establish baseline groundwater quality.
 - Groundwater and Surface Water Interaction - Continuous water level measurements were recorded in 15 monitoring wells for a period of one month. To document long-term changes in groundwater elevations, six rounds of synoptic water level measurements were taken from February to June 2011.
- A Stage IA cultural resources survey was conducted to identify any cultural or archeological resources within the study area. The survey excluded areas of Margaret's

Creek where previous Stage 1A and Stage 1B cultural resources surveys were conducted by OBMUA. Several moderate to high archaeological sensitive locations were identified within or bordering the site.

- Additional surveys may be performed during the remedial design to confirm if they are archaeological sensitive locations. These locations are not expected to be impacted by activities at the site.
- An ecological characterization survey was conducted to characterize habitats in the study area and to identify threatened and endangered species. The survey covered the uplands, beaches and nearshore environment of Raritan Bay.

The Seawall Sector (Areas 1, 2, 3, 4, 5 and 6) samples were collected from upland, beach and tidal areas potentially impacted by slag material in and around the seawall. A total of 291 sediment samples, 219 soil samples and 37 surface water samples were collected from the Seawall Sector.

The Jetty Sector (Areas 7, 8 and 11) samples were collected from upland, beach and tidal areas potentially impacted by slag material in and around the western Cheesequake Creek Inlet Jetty. A total of 165 sediment samples, 52 soil samples and 25 surface water samples were collected from the Jetty Sector.

The Margaret's Creek Sector (Area 9) samples were collected from upland, beach and wetland areas potentially impacted by fill material. A total of 184 sediment samples, 276 soil samples and 21 surface water samples were collected from the Margaret's Creek Sector.

One round of groundwater samples was collected from 21 monitoring wells installed during the field investigation. Wells MW-10S and MW-10D were subsequently resampled to confirm previous lead results.

Biota samples included blue crabs, hard clams, ribbed mussels, killifish, long neck clams, sea lettuce and six species of game fish across the site. Forty soil samples were collected from Areas 2, 3, 5, 6 and 9 for in-vitro bioavailability and electron microprobe analysis for lead and arsenic.

Composite soil samples were collected according to TRW guidance from 203 locations above the spring low tide line and analyzed for lead. Each composite consisted of five subsamples collected within a 50-foot radius of a center point at a depth of 0 to 2 inches to be representative of soil that is likely to be ingested.

Background samples were obtained from locations that, according to the preliminary understanding of contaminant transport pathways at the site, were not expected to be influenced by sources of contamination. Area 10 was selected as the background location for soils, surface water and sediments. Sediment, surface water, soil and groundwater samples were collected to develop site-specific background concentrations. Forty-nine background sediment samples, 25 background soil samples and 11 background TRW samples were collected from Area 10. Twelve background surface water samples were collected from Raritan Bay. Background groundwater

samples were collected from monitoring well MW-11S, which is located upgradient of the site wells.

For the purposes of ecological risk assessment, background wetland sediments were consistent with those in Margaret's Creek were needed, and for this reason, Whaler's Creek was identified as the background location. This area is located out of the watershed and is not impacted or influenced by the site.

Sediment, surface water, soil and groundwater samples were collected and site-specific background concentrations for metals in sediment (both bay and wetlands) and soil were developed for use in the FS.

Slag was observed in seven of the 26 test excavations in Areas 1 and 4. Slag depths ranged from one to five feet below ground surface (bgs). Most of the slag observations were along or near the seawall. In general, lead, arsenic, copper, antimony and chromium exceeded their respective screening criteria in test pit samples collected along or near the seawall. Arsenic also exceeded its screening criterion in one sample collected from the beach in Area 2.

Slag samples and slag cores were subjected to a variety of leaching tests (Schnabel 2011, provided in Appendix B of the FS), including the Synthetic Precipitation Leaching Procedure (SPLP), the TCLP, a semi-dynamic leach test and deionized water (DIW) using the SPLP procedure. These various leaching tests confirm that lead is leachable from the slag under different conditions. Arsenic and antimony were also detected in leachate from various tests exceeding TCLP limit.

Leachability from the slag was also examined in a neutral salt extraction procedure, used to simulate conditions in which slag is exposed to seawater. Under these conditions, lead was determined to be leachable while arsenic, copper, antimony and tin did not leach. It was demonstrated that core samples had considerably higher levels of leachable lead than exterior slag samples, but levels from both core and exterior samples were above the drinking water Maximum Contaminant Level (MCL).

Leaching tests results demonstrated that when slag comes into contact with fresh or salt water, it will leach lead. As a result, the slag must be chemically stabilized to minimize the leaching potential. The potential for the slag to contact water must be minimized, or leachate from the slag must be prevented from discharging into the environment.

TCLP tests were conducted on the battery casings by analyzing three composite samples from battery casing piles in the upland area of the Margaret's Creek Sector, the Area 2 beach and the landward end of the Western Jetty. Lead was the only metal found to leach in significant quantities.

Samples from the Area 2 beach were below the 5.0 milligram per liter (mg/L) regulatory TCLP limit, while samples from the Margaret's Creek Sector and Western Jetty composite samples were both above the TCLP limit.

Visual surveys of slag and battery casing surveys were conducted at the Western Jetty, seawall and Margaret's Creek Sector to determine slag and/or battery casing distribution and volumes. The estimated volume of slag for the Western Jetty is 5,000 cubic yards (CY). The estimated volume of slag for the seawall is 5,300 CY. The estimated volume of battery casings for the beachfront is 70 CY. The estimated volume of slag for Margaret's Creek Sector is 470 CY and of battery casings is 250 CY. The locations of the slag and battery casings (source materials) are shown in Figure 5-1.

5.3 Conceptual Site Model

The CSM integrates all the information collected during the RI to explain the observed distribution of contamination in site media. Figure 5-1 is a graphical representation of the CSM for the site.

Lead, arsenic, antimony, copper, iron and chromium, are the primary contaminants contained in slag. Other metal contaminants include manganese, vanadium and zinc. Demolition debris in the form of concrete and a variety of bricks, including fire bricks, and slag were deposited on the Western Jetty and used as fill and stabilizing material for the seawall. Weathering of the slag can release contaminants into the environment and create secondary sources (e.g., contaminated soils and sediment). Erosion of particulates from the slag is the principal mechanism at the site for the release of metals into the environment. Leaching of metals is a secondary mechanism.

Sediments on the western part of the seawall are entrained in the major long-shore current, which results in sediment transport from east to west, and are deposited on the eastern sides of the first and second jetties which include the Area 2 beach. Sediment mixing by breaking waves in the surf zones tends to move contamination deeper into the sediment bed.

Eroded particulates from the seawall and re-suspended contaminated sediments under most conditions are also transported by a less powerful eastward flowing current, and a portion is deposited in a shoal near the intersection of Area 1 and Area 9. Storm events can increase sediment transport by about four times. Extremely large storm events, on the order of Superstorm Sandy 2012, disrupt typical currents and can result in far greater sediment transport.

The complex currents in the Jetty Sector create depositional areas west of the Western Jetty, at a shoal off the Eastern Jetty and at another shoal off the Western Jetty. Eroded slag particles and dissolved metals from the western side of the Western Jetty accumulate in the depositional area. Eddy currents keep the particles from migrating further west. Eroded material from the eastern side of the Western Jetty is entrained in the strong currents of Cheesequake Creek Inlet where the net sediment flux is toward Raritan Bay. Once in Raritan Bay, some sediments are transported far into Raritan Bay on strong ebb tide currents. Some deposit and accumulate on the ebb shoal just east of the inlet, and some deposit slightly west of the inlet in a dynamic area where mixing of Cheesequake Creek flow and Raritan Bay occurs. Sediments are regularly resuspended and entrained in this mixing zone, settling to the bay floor during slack tides. The result is no regular pattern of deposition in this area.

In the Margaret's Creek Sector, storm water runoff carries particles of eroded waste and dissolved metals from the upland areas to the ponded surface water. Storm water may flow overland along the drainage pathways or percolate into groundwater; however, elevated lead concentrations were not detected in groundwater. The net result of the hydraulic regime and sediment characteristics in Margaret's Creek is that contamination from the upland areas accumulates in sediments in the wetlands. The high-resolution core data show that higher metals concentrations occur beneath the sediment surface and are covered by cleaner sediments.

Dissolved metals can be washed into surface water via tidal flushing or storm water, or percolate into the subsurface. In the surface water, elevated dissolved-phase lead, arsenic and copper were observed in all three sectors. Groundwater flow is affected by the daily tides. Groundwater flow on a whole discharges to the bay but some localized landward flow can occur during flood tides.

Exchange Study Results

The Margaret's Creek exchange study evaluated the exchange of contaminants and sediment between the Margaret's Creek wetlands and Raritan Bay via Margaret's Creek (i.e., water and sediment flux). Water and sediment exchange in Margaret's Creek does not occur on a regular basis since the Margaret's Creek wetlands are at a higher elevation than mean high tide. Therefore, flux out of Margaret's Creek into Raritan Bay was measured. The average daily contaminant flux calculated from Margaret's Creek entering Raritan Bay was approximately 19.1 grams (g) of lead per day. The dissolved portion of the lead flux is estimated not to exceed 6.6 g per day. Margaret's Creek is a very small net exporter of contaminants and sediments into Raritan Bay.

The Cheesequake Creek Inlet Exchange study was conducted to estimate the flux of contaminants through the Cheesequake Creek Inlet. Contaminant flux for various flood tidal stages was estimated using Cheesequake Creek flow measurements and lead, arsenic, copper, antimony and chromium data for surface water samples.

The concentrations of site-related metals in the inlet surface water were much lower than other areas of the site. In terms of bulk sediment and water, Cheesequake Creek was determined to be a net exporter of both sediments and water into Raritan Bay.

5.4 Nature and Extent of Contamination

The evaluation of the nature and extent of contamination initially focused on those constituents identified as site-related contaminants (i.e., lead, arsenic, copper, antimony, chromium and iron) in site sediment, surface water, soil and groundwater. Conservative, health-protective preliminary screening criteria were used in the initial step to identify the nature and extent of contamination in site media. It is important to note that concentrations that exceeded these preliminary screening criteria are not necessarily associated with unacceptable risk to human health or the environment, but were used to define the areas that required further evaluation.

Slag and Battery Casings and Associated Wastes

The slag and battery casings and associated wastes contain high concentrations of lead which pose unacceptable human health and ecological risks, and act as a source of contamination for soil, sediment, groundwater and surface water. As stated previously, the slag was subjected to a variety of leaching tests, which concluded that lead and other metals have the potential to leach under certain conditions to soil, sediment, groundwater and surface water.

The estimated volume of slag for the Western Jetty is 5,000 CY. The estimated volume of slag for the seawall is 5,300 CY. The estimated volume of battery casings for the beachfront is 70 CY. The estimated volume of slag for Margaret's Creek Sector is 470 CY and of battery casings is 250 CY (See Table 5.1).

The primary sources of lead contamination are slag and battery casings. The seawall is up to 80 percent slag. Battery casings were found in the upper two inches of depositional zones in Areas 2 and 5. Buried slag was observed in test excavations on the upland side of the seawall in Area 1 and the eastern end of Area 4.

The Western Jetty and adjacent areas contain slag and some battery casings. The western side of the Western Jetty and the adjacent shoreline are comprised of 80 to 90 percent slag. The prevailing currents in the vicinity of the Western Jetty promote sediment deposition on the western side of the jetty and transport of sediment into Raritan Bay. The fine-grained organic rich sediments in this area tend to sorb metals.

Margaret's Creek contains visible slag waste piles in upland areas of Margaret's Creek. Crushed battery casings were also observed scattered in upland areas of Margaret's Creek. No slag or battery casings were observed in the wetland sediment.

Soil and Sediment

During the RI, multiple rounds of surface and subsurface soil sampling were conducted to investigate potential source areas of contamination, and to evaluate the potential risk to human health and the environment. Both historical information and previous investigations indicated that lead concentrations were detected as high as 198,000 parts per million (ppm). The highest concentration was found in soils near the Western Jetty (Area 8). Soil in many Areas has been impacted by the slag and battery casings and associated wastes. Some of the areas contain slag particles with high concentrations of heavy metals. The contaminated soil serves as a secondary source for sediment, surface water and groundwater contamination. The RI report presents more detailed information with regard to findings of the soil sampling events.

Lead contamination in the sediment was identified in various areas in the Raritan Bay, in particular, areas near the seawall, Western Jetty including Area 7 and Areas 2 and 5. Both historical information and previous investigations indicated that lead concentrations were detected as high as 47,700 ppm. The highest concentration was found in sediments near the seawall (Area 1). The contaminated sediment serves as a secondary source for the surface water contamination. The RI report presents more detailed information with regard to findings of the sediment sampling events.

Along the eastern 1,000 feet of the seawall most of the contamination is in the shallow soils and sediment. In Area 2, in the soils and near-shore sediments, lead and arsenic concentrations both exceeded the preliminary screening criteria. Deeper soils in this area also exceeded both the lead and arsenic human health screening criteria. In Area 5, near the first jetty, co-located lead and arsenic in soil and sediment exceeded the initial screening criteria. Deeper soil and sediment from this area did not. Other site-related metals were detected at some locations where lead and arsenic contamination were not co-located.

The highest concentrations of lead and arsenic in the Jetty Sector sediments, soils and surface water were located on and to the west of the Western Jetty. Sediment contamination, initially defined by the co-location of lead and arsenic that exceeded preliminary site-specific screening criteria, included the area from the Western Jetty westward approximately 200 feet into Area 8 and seaward of the Western Jetty in Area 7. Co-located soil and sediment lead and arsenic above the preliminary site-specific screening criteria extended 1,000 feet northwest of the Western Jetty and westward along the shore into Area 11. In Area 11, co-located lead and arsenic contamination was found along the mean high tide line and the intertidal zone.

Concentrations of lead and arsenic in soils in the Jetty Sector exceeded preliminary site-specific soil screening criteria. The shallow soils most impacted by site-related metals were on and adjacent to the Western Jetty. In deeper soils, lead and arsenic concentrations exceeding the preliminary site-specific screening criteria are limited to the Western Jetty and Area 8 beach.

Sediment samples with lead that exceeded the preliminary site-specific screening criteria were limited to the shallow wetland areas. In deep sediments, lead concentrations above the preliminary site-specific screening criteria were limited to two widely-separated locations. Both of the high-resolution contaminant analysis cores showed that, in the top eight inches of core, lead exceeded the initial human health screening criteria.

No primary sources (e.g., slag or battery casings) were observed in the wetland sediment, which suggests that the source of sediment contamination is weathering of slag and battery casings and storm water runoff from upland sources. Contaminants are dispersed widely across the wetlands, and contamination is generally present only in the top 24 inches.

In soils, lead exceeding the preliminary site-specific screening criteria was identified in nine samples: one in the dunes, two adjacent to Area 1 and six in upland soils. Four shallow soil samples contained co-located arsenic and lead above the human health screening criteria. Two subsurface locations in the upland area exceeded the human health screening criteria for co-located lead and arsenic. The highest concentration of lead was located in the sample adjacent to Area 1. The observed distribution of soil contamination is consistent with a model of non-contiguous “hot spots” rather than area-wide contamination. This finding is consistent with observations that sporadic disposition of waste materials on the ground surface occurred in the upland areas of Margaret’s Creek.

Surface Water

Based on the RI results, surface water in limited areas was found to contain lead, arsenic, copper, iron, manganese, vanadium and zinc from leaching of slag and battery casings and associated wastes, contaminated soil and sediment.

In surface water, lead was commonly detected above the site-specific screening criterion in surface water samples collected from the intertidal zone, between the eastern end of Area 1 and the western end of Area 6; the highest concentrations were in Areas 1 and 2. Arsenic was detected above its site-specific screening criterion less frequently than lead.

The majority of surface water samples collected from the Jetty Sector did not exceed screening criteria. However, two surface water samples in the Jetty Sector exceeded the site-specific screening criteria for lead and arsenic.

Two surface water samples collected from inside the Margaret's Creek channel exceeded site-specific surface water criteria for lead and arsenic. In the western, open-water portion of the wetlands, two surface water samples exceeded the site-specific levels for lead. No surface water samples in the eastern, open-water area exceeded any screening criteria. In Raritan Bay samples in the vicinity of Margaret's Creek, lead in surface water samples were detected above the site-specific screening levels.

5.5 Potential Routes of Migration

The migration of contaminants at the site is currently occurring via several mechanisms, including: migration from the slag and battery casings and associated wastes to surface water, soil and sediments; migration from the soil to surface water and sediments, and; migration from the sediments to surface water, and soil.

Additional discussion of the exchange of contaminants and sediment between the Margaret's Creek wetlands and Raritan Bay via Margaret's Creek (i.e., water and sediment flux) and the estimate the flux of contaminants through the Cheesequake Creek Inlet is provided in Section 5.3.1.

6.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

6.1 Land Uses

The majority of the site is currently zoned as public or vacant land with one parcel zoned for commercial use in the Jetty Sector. Land use at the site currently is recreational and includes a

substantial wetland area located in Margaret's Creek. The site is bordered to the north by Raritan Bay and to the east, west and south by established residential properties. State Highway 35 is located to the south beyond the residential properties. The portion of the site in Laurence Harbor is part of Old Bridge Waterfront Park. The park includes walking paths, a playground area, parking lot, several public beaches and three jetties, not including the two jetties at the Cheesequake Creek Inlet. The portion of the site located in Sayreville contains the Western Jetty, and the foundation remnants of an old restaurant. The seawall, jetties, beach area east of the Cheesequake Creek Inlet and the Western Jetty at the Cheesequake Creek Inlet are popular fishing areas. The beaches east of the Cheesequake Creek Inlet and west of the seawall appear to be the most popular for swimming. The site is located within the 100-year floodplain of the Raritan Bay.

Middlesex County Utilities Authority operates two pumping stations at the site, one at the eastern end (Area 9) and one at the western end (Area 11). A major sewer line connecting the two pumping stations runs across the site along the Raritan Bay shoreline. An additional sewer line runs across the Margaret's Creek upland area between Route 35 and the beach area.

Based on previous meetings with officials of Old Bridge and Sayreville, it is unlikely that the future land use will change from its current uses.

6.2 Groundwater and Surface Water Uses

Most of the groundwater underlying the site is considered by New Jersey to be Class II-A, a potential source of potable water; however, no complete exposure pathways to groundwater at the site are known. A small area located in Area 9 is considered a Class III-B, (where the natural quality of groundwater is not suitable for conversion to potable uses). Groundwater at the site is currently not used for drinking. Municipal water is provided at the site. However, there are no local ordinances currently in place to prevent its potable use, or to prevent drilling of wells.

The future use of the Class II-A groundwater at the site as a potential drinking water source is unlikely. Current and future potable use of groundwater in the Class III-B classification area is prohibited.

Current surface water use is for recreational activities such as swimming, boating, fishing, etc. Surface water drainage in the vicinity of the site is toward tidal creeks and their associated wetlands. The major surface water bodies at the site include Raritan Bay, Cheesequake Creek and Margaret's Creek. These water bodies are subject to tidal fluctuations averaging 5.5 feet. Because the slope of the Raritan Bay floor is very gentle, 400 to 600 feet of the Bay floor are exposed during low spring tide.

7.0 SUMMARY OF SITE RISKS

As part of the RI process, baseline risk assessments were conducted for the site to estimate the risks to human health and the environment. The baseline risk assessments, consisting of a Baseline Human Health Risk Assessment (BHHRA), which evaluated risks to people, and a screening level ecological risk assessment (SLERA), which evaluated risks to the environment, analyzed the potential for adverse effects both under current conditions and if no actions were taken to control or reduce exposure to hazardous substances at the site. As indicated below, based upon the results of the RI and these risk assessments, EPA has determined that active remediation is necessary to protect public health or welfare and the environment from actual and threatened releases of hazardous substances into the environment.

7.1 Summary of the Baseline Human Health Risk Assessment

A BHHRA was conducted to estimate current and future effects of contaminants on human health. A BHHRA is an analysis of the potential adverse human health effects caused by hazardous substance exposure in the absence of any actions to control or mitigate these exposures under current and future site uses. The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. Tables 7-1 through 7-8 provides a summary of relevant information from the BHHRA (i.e. exposure pathways and chemicals found to pose unacceptable risk to human health).

The risk assessment document for this site, entitled Final Human Health Risk Assessment, dated October 2011 and the memorandum Addendum to the Final Remedial Investigation Report, dated August 28, 2012, are available in the Administrative Record file and site repositories.

A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios, as follows.

Identification of Chemicals of Potential Concern – uses the analytical data collected to identify a subset of the chemicals of potential concern (COPCs) at the site for each medium, with consideration of a number of factors explained below.

Exposure Assessment – estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures and the pathways (e.g., ingesting contaminated soil) by which humans are potentially exposed.

Toxicity Assessment- determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of effect (response).

Risk Characterization – summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site-related risks. The risk characterization also identifies contamination with concentrations that exceed acceptable levels, defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as an excess lifetime cancer risk greater than the range of 1×10^{-6} to 1×10^{-4} or, for systemic toxicants, concentrations to which populations may be exposed over a lifetime with adverse health effects (i.e., a threshold approach), often presented as a Hazard Index (HI) greater than 1.0. EPA considers lead to be a unique contaminant because of the difficulty in identifying the classic "threshold" needed to develop a reference dose. Therefore, it is evaluated differently from other contaminants, by using blood lead models. The EPA Office of Solid Waste has also released a detailed directive on risk assessment and cleanup of residential soil lead ("Superfund Lead-Contaminated Residential Sites Handbook." OSWER 9285.7-50, August 2003). The directive recommends that soil lead levels greater than 400 mg/kg are potentially not safe for residential use. Contaminants at these concentrations are considered chemicals of concern (COCs) and are typically those that will require remediation at the site. Also included in this section is a discussion of the uncertainties associated with these risks.

Identification of Chemicals of Potential Concern

In this step, analytical data collected during the RI were used to identify COPCs in the soil, sediment, surface water and groundwater at the site based on factors such as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants as well as their mobility and persistence. Although several metals were detected at concentrations above risk-based screening criteria, lead was the primary risk driver, or COC identified at the site. Only exposure to lead in soil through ingestion posed an unacceptable human health risk, and this is further described below.

Soil samples were collected in 2010. Table 7-1 presents the maximum concentration of lead in soils of 47,700 mg/kg. However, mean soil lead concentrations of 685 mg/kg and 408 mg/kg were used in the integrated exposure uptake biokinetic model (IEUBK); (Table 7-7) and adult lead model (ALM); (Table 7-8), respectively. A comprehensive list of all site COPCs can be found in the Table 2 series of the October 2011 Final Human Health Risk Assessment report.

Exposure Assessment

The Conceptual Site Model for the site was used to develop and identify different exposure scenarios and pathways through which people might be exposed to lead which is the only COC as evaluated in the previous step.

Consistent with Superfund policy and guidance, the BHHRA is a baseline human health risk assessment and therefore assumes no remediation or institutional controls to mitigate or remove hazardous substance releases. Cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the site. The RME is defined as the highest exposure that is reasonably expected to occur at a site.

The exposure assessment identified potential human receptors based on a review of current and reasonably foreseeable future land use at the site. The Raritan Bay Slag site is located on the south shore of the Raritan Bay in a waterfront park that includes walking paths, a playground and several public beaches. Land uses surrounding the site are primarily residential to the east, west and south with the Raritan Bay to the north. The site is currently zoned as public or vacant land with one parcel zoned commercial use in the Jetty Sector. Based on the NJDEP classification of most of the groundwater at the site as Class II-A groundwater (i.e., includes potable usage), a future potable use of groundwater was evaluated.

Based on information gathered during the RI such as zoning and demographic information, several exposure scenarios for the site were selected. Based on the current land use scenario, the following exposure scenarios were evaluated: recreational users in Area 1, Areas 3 through 6 and Area 9; anglers throughout the site except Areas 3 and 4 (biota samples were collected to represent lead in sediment from all Areas except Areas 3 and 4 which are landlocked); pedestrians throughout the site except Areas 2, 8 and 11; trespassers in Areas 2, 8 and 11; outdoor workers in Areas 3 and 4; and construction/utility workers throughout the site.

Based on potential future land uses, the following exposure scenarios were evaluated: recreational users in Area 1 through 6 and Area 9; anglers throughout the site except Areas 3 and 4; pedestrians throughout the site except Areas 8 and 11; trespassers in Areas 8 and 11; outdoor workers in Areas 3 and 4; construction/utility workers throughout the site; and residents throughout the site. Child recreators and fetuses of childbearing women were the only sensitive subpopulations identified for this site.

Potential exposure routes for the site varied by receptors and included ingestion, dermal contact and inhalation of soil particles, ingestion and dermal contact with sediment particles, ingestion and dermal contact of groundwater and surface water, ingestion of biota and inhalation of vapors emanating from the tap during showering and bathing. Table 7-2 presents all exposure pathways considered in the BHHRA and the rationale for the selection or exclusion of each pathway.

Toxicity Assessment

In this step, the types of adverse health effects associated with contaminant exposures and the relationship between magnitude of exposure and severity of adverse health effects were determined. Potential health effects are contaminant-specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health effects.

Under current EPA guidelines, the likelihood of carcinogenic risks and noncancer hazards due to exposure to site chemicals are considered separately. Consistent with current EPA policy, it was assumed that the toxic effects of the site-related chemicals would be additive. Thus, cancer and noncancer risks associated with exposures to individual COPCs were summed to indicate the potential risks and hazards associated with mixtures of potential carcinogens and noncarcinogens, respectively.

Toxicity data for the human health risk assessment were provided by the Integrated Risk Information System (IRIS) database, the Provisional Peer Reviewed Toxicity Database (PPRTV), or another source that is identified as an appropriate reference for toxicity values consistent with EPA's directive on toxicity values. No toxicity values for lead, the risk driving chemical of concern, are available as discussed below. Therefore, Tables 7-3 and 7-4 which would typically include this information are blank. Additional toxicity information for all COPCs is presented in Appendix B in the Table 5 and 6 series of the October 2011 Final HHRA.

Lead is not evaluated in the same manner as other noncarcinogenic contaminants. EPA has not published conventional quantitative toxicity values for lead because available data suggest a very low or possibly no threshold for adverse effects, even at exposure levels that might be considered background. However, the toxicokinetics of lead are well understood and indicate that lead is regulated based on the blood lead concentration. In lieu of evaluating current and future risks using typical intake calculations and toxicity criteria, EPA developed models specifically to evaluate lead exposures. For this BHHRA, blood lead concentrations were estimated using the IEUBK and the ALM. The risk assessment identified a potential for elevated blood lead levels from exposure to the fine fraction of soil in Area 2 under a future child recreator scenario (42% may have blood lead levels greater than 10 micrograms per deciliter) and exposure to site-wide fine fraction soil under a current/future scenario for developing fetuses of adult female construction/utility workers (11% may have blood lead levels greater than 10 micrograms per deciliter). Currently, the EPA health-based goal for blood lead levels in children is no more than 5% of the population having greater than 10 micrograms per deciliter. Tables 7-7 and 7-8 contain model input parameters as well as potential blood lead concentrations.

Risk Characterization

This step summarized and combined outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. Exposures were evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen, using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk (IUR) for inhalation exposures. Excess lifetime cancer risk for oral and dermal exposures is calculated from the following equation, while the equation for inhalation exposures uses the IUR, rather than the SF:

$$\text{Risk} = \text{LADD} \times \text{SF}$$

Where: Risk = a unitless probability (1×10^{-6}) of an individual developing cancer
 LADD = lifetime average daily dose averaged over 70 years (mg/kg-day)
 SF = cancer slope factor, expressed as $[1/(\text{mg/kg-day})]$

The likelihood of an individual developing cancer is expressed as a probability that is usually expressed in scientific notation (such as 1×10^{-4}). For example, a 10^{-4} cancer risk means a “one-in-ten-thousand excess cancer risk”; or one additional cancer may be seen in a population of

10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk) with 10^{-6} being the point of departure.

For noncancer health effects, a HI is calculated. The HI is determined based on a comparison of expected contaminant intakes and benchmark comparison levels of intake (reference doses, reference concentrations). Reference doses (RfDs) and reference concentrations (RfCs) are estimates of daily exposure levels for humans (including sensitive individuals) which are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (*e.g.*, the amount of a chemical ingested from contaminated drinking water) is compared to the RfD or the RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

$$HQ = \text{Intake/RfD}$$

Where: HQ = hazard quotient

Intake = estimated intake for a chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (*i.e.*, chronic, subchronic, or acute).

The key concept for a noncancer HI is that a “threshold level” (measured as an HI of less than 1) exists below which noncancer health effects are not expected to occur.

The HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals which are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncancer health effects on a specific target organ. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Cancer and noncancer risks are typically summarized in Tables 7-5 and 7-6. However, lead is the only risk driving contaminant at the site and it is not evaluated in the same manner as other contaminants. Tables 7-7 and 7-8 contain model input parameters as well as potential blood lead concentrations for both the IEUBK and ALM.

Uncertainty in the Risk Assessment

The process of evaluating human health cancer risks and noncancer health hazards involves multiple steps. Inherent in each step of the process are uncertainties that ultimately affect the final risks and hazards. Important site-specific sources of uncertainty are identified for each of the steps in the four-step risk process below.

Uncertainties in Hazard Identification

Uncertainty is always involved in the estimation of chemical concentrations. Errors in the analytical data may stem from errors inherent in sampling and/or laboratory procedures. Additional COPC identification uncertainties include the following.

Samples were collected from known and suspected areas of contamination (biased high) to estimate reasonable maximum concentrations of contaminants throughout the site. The potential exists that datasets formed by these samples might not accurately represent reasonable maximum concentrations.

Since sediment screening criteria are not available, soil screening data were used as a surrogate which is likely more conservative. As a result, some contaminants of potential concern may have been carried through the risk assessment, likely resulting in an overestimate of the actual risk.

All species of fish collected at the site and used for risk evaluation are highly mobile. During the limited time they reside in Raritan Bay, they are not likely to be closely associated with the site as they are expected to move freely about the bay. Some uncertainties are associated with the representativeness of the fish species used in the risk assessment.

Uncertainties in Exposure Assessment

There are two major areas of uncertainty associated with exposure parameter estimation. The first relates to the estimation of EPCs. The second relates to parameter values used to estimate chemical intake (e.g., ingestion rate, exposure frequency). The following are examples of the latter.

A residential scenario was used to evaluate a recreational exposure to lead in the IEUBK and ALM. Thus, upper end exposure factors were employed, resulting in blood lead levels which were likely overestimated but reasonable.

Surface water was evaluated in Raritan Bay as a whole based on consideration that Raritan Bay is a highly dynamic system. Surface water is constantly mixed and moved around by tidal and wave-driven currents. However, in source areas such as Area 2, there might be a higher localized risk to individuals who incidentally ingest the water. While in most areas of the site, this approach likely overestimated risk, in surface water adjacent to source areas, the risks to future recreational users from lead ingestion may have been underestimated. An additional round of sampling in April of 2011 (not included in the risk assessment) indicated that surface water samples in Area 2 were approximately an order of magnitude lower than the first round. As a

result, calculated risks are likely more accurate for Area 2 while remaining an overestimation for the remainder of the site.

Uncertainties in Toxicity Assessment

A potentially large source of uncertainty is inherent in the derivation of the EPA toxicity criteria (i.e., RfDs, RfCs and SFs). Additionally, the following site-specific toxicity uncertainties were identified.

Arsenic speciation analysis was not performed on biota tissue samples from the site. The BHHRA initially assumed that 100% of the arsenic present in fish and crab tissue was in the inorganic (more toxic) forms, which resulted in unacceptable risk. However, a literature review was performed, indicating that usually less than 10% of arsenic in biota is in the inorganic form, in fact, often times less than 1%. At contaminated sites, up to 30% of arsenic was found to be inorganic so this more realistic value was used and calculations were re-run. The result was that arsenic in biota no longer posed an unacceptable human health threat. Even using 30% of arsenic as inorganic likely overestimates risk from biota consumption at the site since the source of arsenic is slag which is not very bioavailable.

Another important source of uncertainty is bioavailability. The recommended relative bioavailability (RBA) for arsenic is the EPA default value of 60%, which is at the upper end of in vitro bioavailability (IVBA) values observed in the site-specific bioavailability study. The recommended RBAs for lead in total soil samples and in fine soil fraction samples are also based on the upper end of site-specific RBAs. The use of these upper end RBA values could overestimate risk from ingestion of lead and arsenic at the site.

Uncertainties in Risk Characterization

When all of the uncertainties from each of the previous three steps are added, uncertainties are compounded. Since the risk assessment made mostly conservative assumptions, the overall risk assessment likely overestimates risks and hazards as a result of exposure to the site, although this overestimate is assumed to be within the range of the RME.

7.2 Summary of Ecological Risk Assessment

The ecological risk assessment evaluated the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more chemicals or stressors. In the SLERA, the CSM was used to depict the fate and transport of chemicals from source(s) to exposure media (e.g., surface water, sediment and food) and to illustrate potential exposure pathways to ecological receptors. A SLERA was conducted in Areas 1, 8 and 9 to evaluate potential risks to ecological receptors from exposures to surface soil (Area 9 only), surface water, pore water (Area 1 only) and sediment. These three areas were selected for evaluation as they represent areas with source material, complete exposure pathways and desirable habitat for ecological receptors.

Identification of Chemicals of Potential Ecological Concern

Potential ecological risks were assessed by comparing maximum contaminant concentrations to ecological screening values for both aquatic and terrestrial habitats can be found in Table 7-9. Chemicals of potential ecological concern (COPECs) were identified for the aquatic habitat (encompassing both the surface water and sediment) of Areas 1, 8 and 9 and the terrestrial habitat (surface soil) of Area 9. Hazard quotients (HQs) in Table 7-10 were calculated for individual COPECs in surface soil, surface water and sediment based upon conservative screening values (effects-range low for sediment, chronic surface water values, ecological soil screening values). Additionally, food chain modeling was conducted to determine exposure concentrations in upper-trophic level receptors. Quantitative risk estimates were calculated using HQs, which compare the exposure estimates with the selected toxicity reference values (TRVs), to no observable adverse effect level (NOAEL) and lowest observable adverse effect level (LOAEL). The HQ is expressed as the ratio of the estimated exposure dose for the wildlife indicator species to the ecotoxicity benchmarks (i.e., NOAEL and LOAEL TRVs). If the calculated HQ for a NOAEL TRV is less than one, then it is unlikely that that COPEC will result in an adverse effect on that indicator species. Conversely, contaminants with HQs greater than one based upon NOAEL and LOAEL TRVs were identified as COPECs. Site-specific tissue data collected from Area 1 (killifish, ribbed mussel, long neck clam, hard clam and sea lettuce) were used to assess risk to upper trophic level receptors in Area 1. Similar risks were assumed for Area 8 which has comparable habitat and source material.

All contaminants which were identified as COPECs in the SLERA were retained for further evaluation in the Step 3a SLERA Addendum.

The SLERA Addendum entailed refining the list of COPECs by using more realistic modeling scenarios including 1) an exposure point concentration (EPC) of the lower of either the 95 percent upper confidence limit (95% UCL) of the arithmetic mean or the maximum detected concentration for each chemical retained as a COPEC in the SLERA; 2) sediment effects range-medium (ER-M) values [when available]; 3) acute surface water values; 4) frequency of detection; any chemicals detected in five percent or less of the samples in a dataset of twenty samples or more was removed from consideration; and 5) comparison of site inorganics to background 95% UCL concentrations for a specific metal.

Food chain exposure models assessed in the Step 3a evaluation encompassed the use of 95% UCL values for soil, sediment and tissue (where applicable) concentrations for these chemicals found exceeding NOAEL and/or LOAEL-based TRVs in the SLERA. In addition, the models were run using more representative input parameters such as average reported body weights and food ingestion rates, and more realistic site foraging factors (SFF) for model species that are not expected to reside at the site year long, or utilize 100% of the site for foraging. Only LOAEL values were used for the food chain modeling in Step 3a.

Although several types of contaminants were identified in the large quantity of analytical data obtained during the RI, lead was identified as the primary COC for the site based on the RI data and the risk assessments, which indicated that lead contributes the majority of the potential risks in the media evaluated at the site.

Exposure Assessment

An ecological reconnaissance was performed for the site which included an identification of site habitats and ecological receptors. In addition, information regarding threatened and endangered species and ecologically sensitive environments that may exist at or in the vicinity of the site was requested from the EPA and the NJDEP Natural Heritage Program (NHP).

Where intact, several habitats are present onsite, including beach, scrub/shrub, tidal marsh and upland areas; however, a considerable portion of the site is developed and consists of the Old Bridge Waterfront Park. Due to the development of the park, and encroachment of roads and residences, undeveloped land is limited mostly to beaches and Margaret's Creek; however, all parcels have undergone considerable disturbance activities in the past.

The EPA reported that a review of United States Fish and Wildlife Service (USFWS) records indicate that the Indiana bat (*Myotis sodalist*) and swamp pink (*Helonias bullata*) may potentially be present in Old Bridge Township. However, EPA's review concluded that on-site habitats are unsuitable for swamp pink. Indiana bats may utilize larger mature trees in Margaret's Creek (Area 9) during summer months for roosting.

The NJDEP NHP reported that a review of their records indicated that several threatened or special concern species are known to utilize, or occur within ¼ miles of the site. Of the species identified, only osprey (*Pandion haliaetus*) was observed both flying and foraging on site. In addition, remnants of what appeared to be an osprey nest were observed on top of the navigational tower at the end of the Eastern Cheesquake Creek Jetty during Fall 2010 field activities. During field activities conducted in Spring 2011, osprey was observed constructing a nest at this location.

The assumptions and models used to predict the potential exposure of plants and animals to COCs associated with the site are addressed in this component. Exposure parameters (e.g., body weight, prey ingestion rate, home range) of wildlife species selected as representative receptors and site specific biota, sediments, soils and water COC concentrations, were used to calculate the exposure concentrations or dietary doses using food web models summarized in Table 7-11.

Ecological Effects Assessment

Metals were detected at concentrations above ecological screening levels in various site media. Several metals were identified as risk drivers mostly through direct contact with Areas 1 and 8 sediment and Area 9 soil; fewer metals pose a risk via food chain exposure. Model results indicated that lead is the risk driver to both terrestrial receptors and aquatic receptors via dietary exposure.

Measures of toxicological effects were selected based on lowest observed adverse effect levels (LOAELs) and no observed adverse effect levels (NOAELs) from studies reported in the scientific literature. Reproductive effects were generally the most sensitive endpoints.

Ecological Risk Characterization

Multiple lines of evidence, based on various measurement endpoints (measures of effect), were used to evaluate major components of the Raritan Bay Slag Bay Area and Margaret's Creek wetland ecosystem to determine if contamination has adversely affected plants and animals at the site (See Table 7-12). The lines of evidence indicate that the presence of slag and battery casings in these ecosystems have produced adverse ecological effects for both terrestrial and avian receptors.

As discussed in the SLERA addendum, 1) In Area 1 the COCs were lead in sediment and copper and lead (dissolved fraction) in surface water; food chain modeling indicated risk from lead in sediment and mollusks to the invertivorous bird communities based on the semipalmated plover model. These food chain modeling results are also applicable to Area 8; 2) In Area 8, surface water contaminants include (total and dissolved fractions): arsenic, copper, iron, lead, manganese, vanadium and zinc. 3) In Area 9 the COC was lead in soil. Food chain modeling identified risk to insectivorous birds (American robin).

In addition, it was also noted that consumption of slag particles may also pose a risk to avian receptors, a result of ingestion of particles for use within bird crops. This exposure pathway was not quantified.

7.3 Basis for Remedial Action

The BHHRA conducted for the site demonstrated that unacceptable non-cancer hazards are present from future ingestion of soil in Area 2 and current/future ingestion of sitewide upland site soils. No unacceptable cancer risks were identified for current or potential future exposure scenarios.

The results of the SLERA addendum indicate that copper and lead were the only surface water COCs in Area 1, while lead, arsenic, copper, iron, manganese, vanadium and zinc were the COCs for Area 8. Lead in soil and sediment are the only risk drivers to aquatic receptors utilizing Areas 1 and 8 and terrestrial receptors utilizing Area 9 upland areas of the site.

The response action selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

8.0 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) provide general descriptions of what the cleanup is designed to accomplish. They are established on the basis of the nature and extent of contamination at a site, the resources that are currently and potentially threatened and the potential for human and environmental exposure. These objectives typically address both a

contaminant level and an exposure route, because protectiveness may be achieved by reducing exposure (such as source removal) as well as by reducing actual contaminant levels in the media of concern.

RAOs, remediation levels and the cleanup strategies developed for the site assume that the current and future uses of the site will remain as recreational use. Groundwater will remain designated by New Jersey as Class-II-A in most areas of the site with the exception of the Class III-B designation in Area 9. Thus, groundwater will remain a potential source of drinking water in the future.

The following RAOs address the human health risks and environmental concerns at the Raritan Bay Slag site. For soil, unacceptable risks were identified for receptors including children exposed under a future recreational use, the developing fetus of female construction and utility workers under both current and future scenarios and, from the ecological evaluation, aquatic and terrestrial receptors. Sediment and surface water receptors identified in the SLERA include aquatic receptors. Exposure pathways include ingestion of soil, sediment and surface water. The RAOs are organized into the following categories: slag and battery casings and associated wastes, soil, sediment and surface water.

The specific criteria for establishing RAOs can be found in the NCP § 300.430(e) (2) (i).

8.1 Slag and Battery Casings and Associated Wastes

The RAOs for the slag and battery casings and associated wastes (highly toxic source material Principal Threat Waste (PTW)) are listed below.

- Reduce exposure resulting from incidental ingestion of slag and battery casings and associated wastes to levels that are protective of human health.
- Reduce exposure resulting from the ingestion of slag and battery casings and associated wastes to levels that are protective of ecological receptors.
- Reduce migration of contamination from the slag and battery casings and associated wastes to surface water, soil and sediments to levels that are protective of human health and ecological receptors.

8.2 Soil

The RAOs for contaminated soil and highly impacted soil (containing PTW) are listed below.

- Reduce exposure resulting from incidental ingestion of contaminated soil to levels protective of human health.

- Reduce exposure resulting from the ingestion of contaminated soil and ingestion of contaminants via food chain to levels protective of ecological receptors.
- Reduce migration of contamination from the soil to surface water and sediments to levels that are protective of human health and ecological receptors in Area 9.

8.3 Sediment

The RAOs for contaminated sediment and highly impacted sediment (containing PTW) are listed below.

- Reduce exposure resulting from the ingestion of contaminated sediments and ingestion of contaminants via food chain to levels protective of ecological receptors.
- Reduce the migration of contamination from the sediments to surface water and soil to levels that are protective of human health and ecological receptors.

8.4 Surface Water

The RAO for surface water is listed below.

- Reduce metals concentrations to levels that are protective of ecological receptors by remediating source materials.

8.5 Basis and Rationale for Remedial Action Objectives

The basis for the RAOs for slag and battery casings and associated wastes is to remediate based on visual observation (i.e., demolition debris in the form of concrete and a variety of bricks, including fire bricks. observed on-site during remedial action will be removed or remediated). Slag materials that are not readily visible will be remediated as highly impacted soil/sediment containing PTW. Removal will prevent high concentrations of lead which pose unacceptable human health and ecological risks from acting as a source of contamination for soil, sediment and surface water.

Soil in all areas have been impacted by the slag and battery casings and associated wastes. Some of the areas contain slag particles with high concentrations of heavy metals. The contaminated soil poses risks to human health and ecological receptors and also serves as a secondary source for sediment and surface water contamination. Lead contamination in the sediment was identified in various areas in Raritan Bay, in particular, areas near the seawall, Western Jetty and

Area 2. The contaminated sediment poses risks to the ecological receptors and also serves as a secondary source for the surface water contamination. Contaminated and highly impacted soil and sediment above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities.

Note: A single unified cleanup goal was proposed for soil and sediment due to the nature of the site (comingling/relationship between soil and sediment in the intertidal zone areas). There is significant potential for re-contaminating soil or sediment if the two media were remediated to different cleanup levels. Therefore, one unified remediation cleanup level is provided for soil and sediment. Additional details can be found in Section 2.3.3 of the FS for the Raritan Bay Slag Site.

Based on the RI results, surface water is contaminated with lead and other heavy metals from leaching of slag and battery casings and associated wastes, contaminated soil and sediment. Although surface water is not a source, the contamination poses risks to the ecological receptors. The approach to surface water contamination at the site is to remove the slag and battery casings and associated wastes, contaminated soil and sediment that act as sources of contamination to the surface water. This will reduce the surface water contamination over time to acceptable levels. Monitoring will be implemented to assess the effectiveness of the approach by comparing the monitoring results to a set of cleanup goals. Monitoring requirements for surface water will be developed during the design phase.

Slag and battery casings were tested for leaching potential and were found to exceed the 5.0 mg/L RCRA regulatory limit for lead. The results of the TCLP procedures demonstrate that the slag and battery casings fail TCLP and are therefore a hazardous waste. In addition, lead concentrations in both composite and core slag samples were identified at levels ranging from 38,000 mg/kg to 91,000 mg/kg. As such, slag and battery casings are source materials considered to be highly toxic that would present a significant risk to human health or the environment should exposure occur. The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)).

The remedial action will remove slag and battery casings and associated wastes, contaminated soil and sediment thus, eliminating incidental ingestion risk to residents and recreators utilizing the site. The Selected Remedy will remove the concentrations of lead above the cleanup levels in soil and sediment. Noncancer hazards identified in the risk assessment would be reduced below the remedy cleanup levels. In addition, the Selected Remedy will reduce the concentrations of COCs for surface water identified in the risk assessment to levels at or below the performance standards listed below and in Table 5-2 of this ROD. Ultimately, the Selected Remedy will restore the site to unrestricted use.

Cleanup Levels for Chemicals of Concern for the Selected Remedy

Media	Chemical of Concern	Cleanup Level
Soil and Sediment	Lead	400 mg/kg ^a
Surface Water	Arsenic	36 ug/L ^b
	Copper	3.1 ug/L ^b
	Iron	1,000 ug/L ^c
	Lead	24 ug/L ^b
	Manganese	120 ug/L ^d
	Vanadium	20 ug/L ^d
	Zinc	81 ug/L ^b

^aNJDEP Soil Remediation Standard for residential soils

^bNJDEP Surface Water Quality Standard

^cNational recommended Water Quality Criterion

^dEPA Biological Technical Assistance Group screening benchmark

9.0 DESCRIPTION OF ALTERNATIVES

CERCLA requires that each remedial alternative be protective of human health and the environment, be cost-effective, comply with other statutory laws and utilize permanent solutions, alternative treatment technologies and resource recovery technologies to the maximum extent practicable. In addition, the statute includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility or volume of hazardous substances.

The guidelines and requirements established in the NCP are also considered in the development of alternatives. EPA has recognized that at certain sites, the use of treatment technologies and the development of a wide range of remedial options may not be practicable.

Potential applicable technologies were identified and screened using effectiveness, implementability and cost as the criteria, with the most emphasis on the effectiveness of the remedial technology. Those technologies that passed the initial screening were then assembled into five remedial alternatives. At this site, source removal and hot spot removals were included in the range of remedial options.

9.1 Common Elements and Distinguishing Features of Alternatives

This section of the ROD describes those components that are common to various subsets of the remedial alternatives except the No Action Alternative.

Excavation and or Dredging

All the alternatives, with the exception of the No Action Alternative 1, include excavation/dredging of slag, battery casings and associated wastes, some volume of offsite disposal of contaminated soil and sediment and monitoring. A total of five alternatives were carried through the screening process presented in the Comprehensive Site-wide FS. Please refer to Section 3, Development of Remedial Action Alternatives, and Section 4, Detailed Analysis of Alternatives, of the FS for a more detailed discussion of all the remedial alternatives.

Engineered Containment Structures or Cells

This component would be applicable to Alternatives 3, 4 and 5, which would involve the construction of above-ground engineered containment structures or containment cells to isolate the contaminated material from exposure to the environment and receptors. Under the Superfund Area of Contamination (AOC) Policy (October 1998), wastes consolidated within an AOC are not required to meet the Resource Conservation and Recovery Act (RCRA) Land Disposal Restoration (LDR) requirements. Hence, no additional treatment would be required if contaminated materials are consolidated within an AOC.

The containment cells for Alternatives 3 through 5 would be located in the Margaret's Creek upland area and Western Jetty. Considerations such as dimensions, volume of materials placed and the locations of the cells that are specific to each alternative are discussed under each individual alternative.

The engineered containment structures or cells would consist of features that isolate the contaminants within these structures and prevent migration of contamination. The exterior of the cells would consist of berms constructed of soil or fill material and lined inside with impermeable material. The construction of these cells may occur concurrently during removal, excavation, or dredging operations at the site. The layers of materials that the inside of the containment cells would be constructed with are listed below from bottom to top.

- Bottom liners made of impermeable material
- Drainage pipes for leachate collection
- One foot layer of sand for bottom drainage
- Contaminated material
- Six inches of sand at the top for gas venting layer
- Top liner made of impermeable material
- Twenty-four inches of sandy loamy material at top
- Six inches of topsoil
- Seeding

The leachate from the drainage pipes would be collected in a tank and disposed of at an approved hazardous waste facility periodically.

Once the construction of the outside berm and the bottom liner of the cells is completed, slag and battery casings and associated wastes would be placed inside the cells first. Following this, if the

approach taken by the alternative includes placement of the contaminated soil/sediment, then the contaminated soil/ sediment would be mixed with drying agents. Even though the addition of these agents would not be required under the Superfund AOC policy, the drying agents would improve the ability to handle any wet material and would minimize leachate generation after placement of the materials in the containment cells.

The surficial geologic map of the site Areas, where containment cells would potentially be located, shows that the material is mostly silt or clay that is partially organic. This could potentially result in settlement issues following the construction of containment cells. Hence, prior to construction, vibro-flotation or equivalent techniques would be utilized in order to minimize the occurrence of future settlement. If the containment cell locations fall within the 100-year flood zones based on the Federal Emergency Management Agency (FEMA) floodplain maps, then additional engineering controls would be required to avoid the impacts of floods on the cells. During the remedial design when the exact locations of these cells would be finalized, it would be verified whether they comply with the zoning regulations. Additionally, the impact of the cells in the Margaret's Creek wetlands would also be evaluated in detail during the remedial design stage.

The long-term maintenance and monitoring program would be developed at the time of preparing the remedial work plan and the deed notice. Consistent with Superfund guidance, for cost estimating purposes, it is assumed that the long-term maintenance and monitoring program period is 30 years. However, it should be noted that this monitoring would be required in perpetuity. The monitoring activities would involve periodic inspections of the area to assess erosion and to confirm the structural integrity of the containment cell or cap, checking for proper drainage (for containment cells) or damage (for containment cells and cap) post storm events, and periodic groundwater monitoring in the downgradient vicinity of the containment cell in order to ensure effectiveness of containment. Maintenance for containment cells would include activities such as mowing the grass and re-seeding, as necessary. Maintenance of in-situ cap would involve replenishment of reactive media or reinforcing the armoring layer of the cap. The cells and/or cap would be monitored quarterly for the first two years, semi-annually for the next three years and annually thereafter. A biennial certificate form would be filed with NJDEP every two years to demonstrate that the cells and cap are properly maintained and continuously providing protection to human health and the environment.

As part of the five-year reviews required by CERCLA, EPA would assess the ongoing performance and protectiveness of the remedy. The evaluations would be based on the data collected during long-term monitoring.

Permitting

Compliance with the substantive permitting requirements will be met for all permits identified within this ROD and required to conduct the Selected Remedy. Dredged material from New Jersey's coastal or tidal waters is regulated under the provisions of the following statutes: New Jersey Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.), Waterfront Development Law (N.J.S.A. 12:5-3 et seq.), Riparian Interests (N.J.S.A. 12:3-1 et seq. and 18:56-1 et seq.), Federal Water Pollution Control Act of 1972 as amended by the Clean Water Act of 1977 (33 U.S.C. §

1251), and Federal Coastal Zone Management Act (16 U.S.C. §§ 1451 et seq.) and/or other relevant statutes and implementing regulations.

The proposed dredging of sediment and disposal would require state and local permit equivalencies prior to construction. The permits specific to Superfund AOC policy that govern the placement of contaminated materials within the cell may also be required. Additionally, when the cell location is evaluated during the remedial design stage for zoning compliance and the impacts on the Margaret's Creek wetlands, the need for any additional permits would be determined. Refer to Sections 4.3.3 and 4.3.4 of the FS for the Raritan Bay Slag Site for additional information on these permits.

Disposal and Dewatering

The disposal requirements for all alternatives would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP criteria would require treatment to meet the LDR Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill, which is a RCRA permitted hazardous waste disposal facility. Certified clean material/fill/sands would be placed as appropriate at the excavated areas.

Dewatering would be applicable to all alternatives except the No Action Alternative that involve removal of sediment and excavation of beach sand above the groundwater. Since a large portion of the remediation target area would be within the intertidal zone or seaward of the mean high tide line, including areas that are up to approximately 1,500 feet into Raritan Bay from the mean low tide line, a significant amount of excavated soil or dredged sediment material would need to be dewatered prior to disposal, containment, or treatment. Depending on tide conditions, soil in areas upland of the mean high tide line may need some dewatering. To the maximum extent possible, excavation would be performed during periods of low tides in order to reduce the need for dewatering. The degree of sediment dewatering would depend on the dredging method. Due to the potential presence of debris in the soil and sediment in the Bay areas, it was assumed during the preparation of cost estimates that mechanical dredging would be performed. However, the final decision on the dredging method during implementation would be made during the remedial design. Additionally, in order to implement certain alternatives such as installation of the sediment cap or for certain locations to be accessible during removal of source materials, soil excavation or sediment dredging, continuous maintenance of dewatered conditions for a temporary period from a few hours to a few days may be required.

Dewatering of excavated/dredged material would be performed on-site either on the barge during the dredging and/or in a staging area at a convenient location that is upland of the mean high tide line and unaffected by tides. For ease of access to off-site transportation and to minimize human exposure, most of these on-shore dewatering areas would likely be located near the beach areas or upland areas of the Margaret's Creek Sector or near the Western Jetty. Dewatering of excavated material in onshore areas would be accomplished using an aboveground bermed area constructed of clean soil and lined with an impermeable membrane. Following initial decantation, the partially dewatered material may be mixed with drying agents to reduce the time required for dewatering. The purpose of the addition of drying agents is to remove free water and to improve handling characteristics of the soil and sediment following removal. However, the

addition of drying agents would increase the volume of the material. During the preparation of cost estimates, it was assumed that the volume would increase due to the addition of drying agents by 4%.

Water in the vicinity of active excavation areas or construction areas where dewatered conditions need to be maintained would be collected and pumped. A temporary berm or sheet pile wall would be constructed around this area to control tidal intrusion during excavation or cap installation.

The water generated from the decantation of the dredged/excavated material or from the pumping would be routed to temporary lined sedimentation basins or frac tanks to achieve solids removal. The decanted water would be treated using appropriate technologies to comply with permit requirements prior to discharge into Raritan Bay. The accumulated sediments would be included with the excavated materials for disposal, containment or treatment.

Institutional Controls

Institutional controls (ICs) such as a deed notice or restrictive covenant would be required for portions of the site as one component of maintaining the long-term protectiveness of all alternatives with the exception of Alternative 2.

The types of institutional controls employed at the source areas would include: deed restrictions, giving notice to prospective future owners of the existence and nature of the contamination remaining on-site, and limiting disturbance of the containment areas; other proprietary controls such as easements and covenants, and; governmental controls such as zoning requirements to prevent use of areas that would pose an unacceptable risk to receptors. Information device controls (e.g., advisories, additional public education, Notices of Environmental Contamination) would also be employed to limit exposures to contamination. Some or all of the following measures would be implemented in areas of the site.

- Restrictions on drilling wells in select areas where controls are instituted
- Restrictions on groundwater use in select areas where controls are instituted
- Programs to increase community awareness of potential hazards of exposure to contaminant compounds, ways to prevent exposure and information on the remedial measures that would be implemented as part of the selected alternative

In addition to institutional controls, engineering controls such as restrictions on recreational activities through fencing or signs in select areas where controls are instituted may be required.

In addition, five-year reviews would also be performed as required by CERCLA. All IC measures would be re-evaluated as part of five-year reviews and decisions regarding the continuation, revisions to the ICs or inclusion of additional ICs would be made based on available data. A detailed IC implementation strategy can be identified and refined in the design, as necessary. Entities responsible to carry out the ICs and ensure that they are functioning as intended will be identified in the design.

Monitoring and Long-Term Monitoring

While exposure to surface water or groundwater did not pose any unacceptable human health risks, surface water concentrations did indicate the potential for ecological risks and monitoring is proposed for alternatives other than Alternative 1 to assess impacts from remedial activities and to ensure that surface water concentrations decrease below acceptable levels once source materials are removed. Monitoring would consist of periodic sampling and analysis for lead and other TAL metals. The sampling frequency would be determined during the remedial design.

Long-term monitoring would apply to all the proposed alternatives (other than Alternatives 1 and 2) that include on-site containment or *in situ* capping, wherein contaminated materials would be left on-site under these alternatives. Long-term monitoring would include periodic groundwater, surface water and/or sediment sampling and analysis, in order to monitor contaminant concentrations over time in the vicinity of on-site containment cells or *in situ* cap. These long-term monitoring activities do not include other limited site-wide monitoring or post-removal sampling that may be performed for shorter durations following removal. The long-term monitoring program focuses on the areas in the vicinity of the containment cells or in-situ cap and the objectives of the program are outlined below.

- Identify any potentially toxic and/or mobile transformation products
- Assess the effectiveness of remedial action implemented
- Verify that the extent of contamination is not expanding downgradient, laterally or vertically
- Verify no unacceptable impact to potential receptors
- Detect new releases of contaminants to the environment or migration of existing contamination that could impact potential receptors
- Demonstrate the efficacy of institutional controls that were put into place to protect potential receptors
- Verify attainment of RAOs

Long-term monitoring data would be evaluated and used to make decisions regarding the adequacy and continuation of the monitoring program. Decisions resulting from the evaluation of the data may include:

- Continue monitoring program without change
- Modify the monitoring program
- Modify institutional controls
- Implement a contingency or alternative remedy
- Verify remedial goals have been met and terminate performance monitoring

The primary parameters to be monitored would be lead and other TAL metals, geochemical indicators (e.g., oxidation-reduction potential, dissolved oxygen and pH), and hydrogeologic parameters (e.g., elevation of groundwater in monitoring wells). Increases and decreases in monitoring frequency may occur over the life of the remedy in response to changes in site conditions and monitoring needs. Monitoring requirements for surface water and sediment would be finalized during the design phase.

For cost estimating purposes, quarterly monitoring for the first two years, semi-annual monitoring for the next three years and annual monitoring thereafter for TAL metals (including lead), geochemical indicators and hydrogeologic parameters for a period of 30 years is assumed. Groundwater and surface water would be monitored at a network of sample locations in the vicinity of containment cells and/or in-situ cap as applicable. These locations would be finalized as part of remedial design.

In addition periodic inspections and maintenance activities would be performed for the on-site containment cells and/or the in-situ cap. Periodic inspections of containment structures and monitoring of surrounding groundwater conditions around the containment structures would be performed to:

- Ensure that the cell or cap is successfully mitigating contaminant migration
- Confirm that the cell or cap is effective in reducing any current or future risks of exposure to acceptable levels
- Assess if repairs or additional remedies are necessary

The long-term maintenance and monitoring program would be developed at the time of preparing the remedial work plan and the deed notice. For cost estimating purposes, it is assumed that the long-term maintenance and monitoring program period is 30 years. The monitoring activities would involve periodic inspections of the area to assess erosion and to confirm the structural integrity of the containment cell or cap, checking for proper drainage (for containment cells) or damage (for containment cells and cap) post storm events and periodic groundwater monitoring in the downgradient vicinity of the containment cell in order to ensure effectiveness of containment. Maintenance for containment cells would include activities such as mowing the grass and re-seeding, as necessary. Maintenance of in-situ cap would involve replenishment of reactive media or reinforcing the armoring layer of the cap. The cells and/or cap would be monitored quarterly for the first two years, semi-annually for the next three years and annually thereafter. A biennial certificate form would be filed with NJDEP every two years to demonstrate that the cells and cap are properly maintained and continuously providing protection to human health and the environment.

As part of the five-year reviews required by CERCLA, EPA would assess the ongoing performance and protectiveness of the remedy. The evaluations would be based on the data collected during long-term monitoring.

Coastal Wetland Restoration and Monitoring

Restoration and monitoring of the Bay area coastal wetlands would also be performed along with the other site restoration activities described above. These coastal wetlands restoration and monitoring activities would likely be implemented over several years. Depending on the conditions of the substrate, backfilling with clean sand or other appropriate materials may be necessary. Vegetation would need to be planted to restore the functionality of the area. The restoration process would take several years. Since a depth-based approach would be adopted for dredging, placement of clean material would be relied upon for the following reasons:

- To prevent exposure to any contaminated residuals,
- To maintain long-term protection given the expected wave and current generated shear forces and
- To provide a clean layer for restoration of the benthic habitat.

If deemed appropriate, other coastal wetland restoration measures would potentially be considered during remedial design. These measures may include development of compensatory coastal wetlands in the upland areas of the Margaret's Creek Sector or other areas of the site or site improvements that would accelerate restoration of wetland areas. In accordance with Clean Water Act Section 404, Protection of Wetlands E.O. 11990, 40 CFR 6 App A, all activities that would be proposed as part of coastal wetlands restoration would be summarized in a "Wetlands Assessment and Restoration Plan" that would be prepared prior to the implementation of remedial activities described under this alternative. This plan would discuss the potential impacts or disturbances on the wetlands due to the remedial activities. Additionally, whenever possible, Management Practices (according to Federal Register Vol. 51, No. 219, Part 330.6) would be followed during the design/implementation of the remedy to minimize unavoidable impacts (e.g., spread of contaminants, roadways) to wetlands to the maximum extent practicable.

In addition to activities discussed under the monitoring section below, monitoring specific to coastal wetlands restoration in Bay areas would be performed in order to assess the impacts to the area during the implementation of the remedy and to track and confirm the progress of coastal wetland re-establishment following the restoration activities. These monitoring activities would involve periodic inspections of the conditions of the vegetation and core sampling of sediment in the coastal wetland areas of the Bay areas. Additional restoration activities may be performed based on periodic review of the data obtained during the wetlands monitoring.

Surface Water Monitoring

In addition to post-removal sampling, monitoring would be performed for a limited time following the remedial action to confirm that there are no increased risks due to removal activities. Surface water monitoring would be performed until the remediation goals have been achieved, following the completion of excavation/dredging. Monitoring would consist of periodic sampling and analysis for lead and other TAL metals. The sampling frequency would be determined during the remedial design.

Green Remediation Considerations

Green remediation objectives would be implemented by planning the field activities to minimize fuel usage and impact to the environment. Planning practices that would minimize environmental impact include, but would not be limited to:

- Minimize number of field mobilizations
- Use local labor to reduce fuel consumption associated with driving to the site
- Schedule sampling to minimize shipping
- Sequencing the removal and restoration activities to minimize on site handling of materials and fuel consumption
- Schedule transportation for off-site disposal or import of clean rocks to minimize the number of trips and fuel consumption

- Coordinate the activities that address the different media such as source materials, soil and sediment with each other
- Use ultra low sulfur diesel or fuel-grade biodiesel as fuel
- Use non-phosphate detergents for decontamination
- Purchase locally supplied materials
- Avoid or reduce engine idle time

Five-Year Reviews

Five-year reviews are an element common to all alternatives, except Alternatives 1 and 2 and would be performed as required by CERCLA. Because most of the remedial alternatives will result in some contaminants remaining on the site above cleanup levels that would not allow for unrestricted use (except Alternative 2), a review of these remedies will be conducted every five years, at a minimum. Five-year reviews are required on all Superfund sites when there is waste left in place. For Alternatives 3, 4 and 5, five-year reviews would be conducted in perpetuity.

All IC measures would be re-evaluated as part of five-year reviews and decisions regarding the continuation, revisions to the ICs or inclusion of additional ICs would be made based on available data. Evaluations would be conducted and would allow EPA to assess the ongoing risks to human health and the environment posed by the site. The evaluations would be based on the data collected during long-term monitoring. Entities responsible to carry out the aforementioned tasks and ensure that they are functioning as intended would be identified during the design.

9.2 Description of Remedy Components

CERCLA requires that any remedy selected to address contamination at a hazardous waste site must be protective of human health and welfare and the environment, cost-effective, in compliance with regulatory and statutory provisions that are ARARs and consistent with the NCP to the extent practicable. The FS for the Raritan Bay Slag site evaluated five alternatives for the final cleanup at the site. Associated alternative figures can also be found in the FS report. A detailed description of each alternative is provided below.

Alternative 1 - No Action

Capital Cost: \$0

Total Operation and Maintenance (O&M) Costs: \$0

Total Present Worth: \$0

Implementation Timeframe: Not Applicable

The No Further Action Alternative was retained, as required by the NCP, and provides a baseline for comparison with other alternatives. No remedial actions would be implemented as part of the No Further Action Alternative (beyond those remedial and removal actions already completed).

Under this alternative, no action would be implemented to restore the contaminated soil or sediment or to remove the source materials. Contamination would continue to migrate from the slag to other media such as sediment and soil, and subsequently to surface water and groundwater. Additionally, lead would continue to migrate from the slag and battery casings and associated wastes through the following migration mechanisms:

- Weathering of the source resulting in migration to soil/sediment media
- Leaching resulting in migration of contamination to surface water in the Jetty and Seawall Sectors

Once the surface water and sediment are contaminated, currents driven by waves, winds and tides transport particulate or leached contamination away from the slag and battery casings in the Jetty and Seawall Sectors. In the Margaret's Creek Sector, the transport of contamination from the principal threat wastes (slag, battery casings and highly contaminated soil) occurs primarily through storm water runoff. Potential human and ecological receptors would continue to be exposed to contamination at the site.

Alternative 1 does not include any institutional control or other measures that would be likely to reduce any of the exposures to human and ecological receptors. This alternative also would not include any long-term monitoring activities that may assess the nature and extent of contamination. Implementation of green remediation and sustainable practices would not be considered for this alternative as no action would be taken. Five-year reviews would not be conducted by EPA to assess site conditions.

Alternative 2 – Excavation/Dredging, Off-site Disposal and Monitoring

Capital Cost: \$78,200,000

Total O&M Costs: \$500,000

Total Present Worth: \$78,700,000

Implementation Timeframe: 2 Years

This alternative addresses the slag and battery casings and associated wastes, and contaminated and highly impacted soil and sediment and consists of the following major components and subcomponents.

- Pre-design investigation
- Removal of all source materials and contaminated soil and sediment in all areas, including:
 - Segregation and removal of slag
 - Removal of battery casings and associated wastes
 - Excavation of contaminated soils and dewatering if necessary
 - Dredging and dewatering of contaminated sediment including hot spots
- Post-removal inspection and sampling
- Transport and off-site disposal of excavated/dredged/removed materials
- Restoration of areas impacted by slag and battery casings and associated wastes, excavated areas and dredged areas (if necessary)

- Coastal wetland restoration and monitoring in bay area wetlands
- Surface water monitoring
- Green remediation considerations
- Permitting

Although a five-year review would not be required since this alternative results in an unlimited use/unrestricted exposure scenario, a policy review may be conducted within five years of completion of construction if all RAOs have not yet been achieved. As summarized in Table 5-3, 11,100 CY of source materials would be disposed of at appropriate off-site facilities. The volumes of soil and sediment addressed by remedial components under this alternative are approximately 81,000 CY of soil and sediment, which would be addressed by off-site disposal.

Health and safety precautions and protocols, including establishment of exclusion and contaminant reduction zones, dust suppression, use of personnel protective equipment (PPE) and monitoring would be followed during all stages of removal, handling and disposal of contaminated source materials and during restoration activities to reduce risks to workers. Prior to the implementation of the remedy, a health and safety plan including an air monitoring plan would be developed to address the health risks to workers and the community during remedial activities and the mitigation activities that would address those risks. Either water or chemical-based dust suppression would be used to prevent contaminated dust particles from becoming airborne and potentially posing an inhalation exposure risk. Temporary gravel access roads would be constructed as necessary to limit disturbance of contaminated materials during the implementation of these components of the alternative. The location of the existing 30-inch diameter ductile iron sewer line in the Margaret's Creek Sector and the force main connecting the sewage treatment plant in Old Bridge with the pump station in Sayreville would be taken into consideration during the construction of these access roads. Additional details of each of the components are provided below.

Remedial Design Investigation

During the remedial design, a pre-design investigation would be performed to refine the remediation areas and to obtain any additional parameters, which may include analytical, hydro-geological or geochemical parameters. The locations and parameters for the pre-design investigation would be determined prior to the remedial design. Results from the pre-design investigation would be used to estimate the area and volume of excavation during remedial design. Similarly, the vertical extent of slag and battery casings and associated wastes to be remediated needs to be further delineated through test pits or other methods.

Waste characterization sampling would be performed to determine the appropriate disposal options of the removed material. Samples would be collected separately for slag and battery casings and associated wastes. Samples would be collected from the most contaminated soil and sediment areas as well as areas with less contamination as indicated by the RI data. Additional geotechnical investigations may be conducted to determine the ability of the soil to withstand the loads during construction activities. Soil cores near the seawall, the Western Jetty and Margaret's Creek upland areas would be collected and analyzed for geotechnical parameters such as Uniaxial Compressive Strength.

Removal of All Source Materials and Contaminated Soil and Sediment in All Areas

Segregation and Removal of Slag

All of the following slag materials that act as sources of contamination and are located in different sectors of the site would be removed as part of this alternative.

- Slag materials in the Western Jetty
- Slag materials in the seawall
- Pieces of slag co-mingled with crushed battery casing materials and associated wastes in the Margaret's Creek Sector

Equipment capable of handling the boulder-sized slag such as an excavator or a crane equipped with a boulder-clamp attachment would be used during removal and loading/unloading operations involving the slag materials in the Western Jetty and the seawall. In addition, standard excavation equipment may be used for handling smaller pieces of slag in the Margaret's Creek Sector and in the Jetty/Seawall Sectors. The removed slag materials would be placed in appropriate staging areas within each sector prior to further transportation.

For the Western Jetty, the slag material would be removed from the surface (top and sides) of the jetty without removing the boulders at the bottom half of the jetty. For the Seawall Sector, all the slag material present in the entire seawall would be removed. In order to accomplish this, the existing clean rock material that is co-mingled with slag material would be segregated and placed temporarily in the seawall area. Following the removal of all slag and associated waste from the seawall, the clean rock would be placed back in the seawall as appropriate and may be supplemented with imported clean rocks as necessary. Segregation and removal of slag from the clean rocks would be based on visual determination.

The slag materials in the Margaret's Creek Sector are co-mingled with battery casings and associated wastes and occur in smaller pieces. Standard equipment for excavation would be sufficient to remove the slag materials in this area.

Removal of Battery casings and associated wastes

In the Jetty Sector and the Seawall Sector, the battery casing materials are present in a crushed state and are co-mingled or buried in the soil. Hence, they would be addressed as part of the alternatives for soil. The battery casings and associated wastes in Margaret's Creek Sector are co-mingled with small pieces of slag. They would be removed together with the slag using standard excavation equipment and placed in the appropriate staging area within the Margaret's Creek Sector prior to transportation.

Source materials that are buried in the soil or sediment in any area of the site would be addressed as part of the removal of soil or sediment, respectively. The estimated quantity of slag and battery casings and associated waste to be removed is summarized in Table 5-3. A total volume

of approximately 11,100 CY of slag and battery casings and associated wastes was estimated based on the visual survey.

For cost estimating purposes, it was assumed that additional soil/sediment of up to two feet depth below the seawall slag would be removed as part of the soil/sediment removal. This additional volume is included as part of the soil/sediment volumes in Table 5-3.

Excavation of Contaminated Soils and Dewatering if Necessary

Contaminated soils including highly impacted soil containing PTW would be excavated using standard construction equipment. Excavated soil would be stockpiled in separated areas based on the estimated level of contamination. For areas where the surface soils are clean but subsurface soils are contaminated, the clean surface soils would be stockpiled separately from the contaminated soils during excavation and placed back appropriately during restoration and backfilling activities. For this FS, the volumes of soils to be remediated were estimated based on existing soil sampling data. The depth of excavation is assumed to be two feet bgs for soil in most locations at the site. In certain locations in Area 2, the maximum depth of excavation is assumed to be 10 feet bgs based on the data. Excavated areas would be backfilled with clean fill material. During the remedial design, the area and volume of contaminated soil exceeding the cleanup levels of COCs would be more accurately determined based on the pre-design investigation data. The estimated quantity of contaminated soil to be excavated is summarized in Table 5-3. A total volume of approximately 47,000 CY of contaminated soil was estimated. This volume includes contaminated soil below the seawall for up to a depth of two feet.

Groundwater at the site ranges from a few feet bgs near the bay to 30 feet bgs inland (at well MW11S) and excavation would be scheduled for periods of low tide so major dewatering operations could be avoided. However, soil excavated from areas nearest the mean high tide line may require dewatering as described in Section 9.1.3. The wastewater generated during the dewatering operations would be treated with appropriate technologies if required and the soil generated from the dewatering operations would be combined with the contaminated soil for off-site disposal. For areas with deeper excavations, sloping or benching would be used, as needed. Storm water run-on and runoff would be controlled at excavation areas during remedial construction by installing temporary storm water/erosion control features, such as berms and silt fencing to divert storm water away from excavation areas and to minimize storm water runoff from excavation areas. Soil stock piles would be covered by tarps to serve as dust control and to prevent erosion and transport of contaminated soils during storm events.

To minimize airborne contamination from excavation and handling of COC-contaminated soil dust would be controlled through the use of water or commercial dust suppressants during excavation.

Dredging and Dewatering of Contaminated Sediment Including Hot Spots

In the subtidal areas, contaminated sediment above cleanup levels and highly impacted sediment containing PTW including hot spots would be removed by dredging. For cost estimating purposes, mechanical dredging using a crane with a clam shell bucket mounted on a barge was assumed for transportation of the sediment to the staging area. Dewatering of the sediment would

either be performed on the barge or onshore in the staging area. One onshore docking location would be set up in the seawall sector for unloading the dredged sediment from the barge. Access ramps may be constructed from the beach areas or other on-shore areas to the dock to facilitate transport of sediment. From the dock, sediment would be moved using standard excavation equipment or vacuum trucks. Dewatering the sediment would be performed by decantation with some additional mixing with a drying agent if required, as discussed under Section 9.1.3. The wastewater generated during the dewatering operations would be treated with appropriate technologies if required and the sediment generated from the dewatering operations would be combined with the contaminated sediment for off-site disposal.

In the intertidal beach areas in the Seawall Sector and in Areas 8 and 11 of the Jetty Sector where the contaminated sediment is reasonably sandy, excavation of sediment during periods of low tides may be performed using standard excavation equipment in areas that are accessible.

Based on the cleanup levels, the thickness of the removed sediment is between two to four feet bgs in most areas of the site and deeper in select portions of Areas 2 and 8. The estimated quantity of contaminated sediment to be dredged/excavated is summarized in Table 5-3. A total volume of approximately 34,000 CY of contaminated sediment is estimated. To minimize rejection of waste at the disposal facility, approximately 20 percent by weight of additional drying agent would need to be added to the dewatered sediment to absorb any remaining moisture prior to transportation for off-site disposal. Additionally, pads can be placed on top of the contaminated material during transportation to absorb any liquid developed during transportation.

Post-removal Inspection and Sampling

Inspections would be performed during and after the removal operations to ensure that no visually observed slag materials or battery casings and associated wastes remain on-site. If the inspections show that residual contaminated source material exists in the areas from which source materials were removed, then additional removal operations would be conducted until the inspections confirm the absence of source materials in these areas.

For soils, post-excavation sampling would be conducted prior to backfill at the excavated areas to verify achievement of the cleanup levels. NJDEP Technical Rules require one soil sample per every 900 square feet of excavation floor, and one soil sample per 30 linear feet of each excavation sidewall.

For sediment, core sampling and bathymetric surveys would be performed before and after performance of the remedial activities to confirm dredge depth, to document depth profile and to verify the achievement of cleanup levels. For cost estimating purpose, one core sample would be collected for every 900 square feet of dredged area. A similar bathymetric survey and core sampling program would be implemented to monitor sediment recovery and redistribution following the completion of remedial activities. Additional surface water monitoring would be performed as discussed below under monitoring section.

Transport and Off-site Disposal of Excavated/Dredged/Removed Materials

The total volume of contaminated materials under each medium that is designated for off-site disposal is presented as part of Table 5-3. Under this alternative, all the contaminated materials at the site are addressed by off-site disposal.

Slag and Battery casings and associated wastes

The removed contaminated materials would be transported off-site and placed within one or more permitted off-site disposal facilities specifically authorized by EPA and state regulatory agencies. Since the slag materials and battery casings and associated wastes are RCRA hazardous waste, they would likely require disposal at a Subtitle C landfill. Depending on the requirements of the disposal facility, additional processing of the boulder-sized slag such as crushing may be required to reduce the particle size. Stabilization and/or solidification of the source materials may also be performed to satisfy facility disposal requirements.

Excavated Soil

The excavated soil would be disposed of at permitted off-site disposal facilities. During the RI, samples were collected from the investigation derived waste (IDW) containers and tested using TCLP. The test results indicated that the IDW was non-hazardous waste. However, due to the high concentrations of lead in some areas, for FS cost estimating purposes, it is assumed that up to approximately 20% of the total volume of soil to be excavated would be classified as RCRA hazardous waste (D008) and would be disposed of at a Subtitle C landfill. The hazardous soil would require treatment at the disposal facility to meet the land disposal requirements prior to landfilling. The remaining soil would be non-hazardous and would be disposed of at a Subtitle D landfill without treatment.

Dredged Sediment

Contaminated sediment would be transported to the staging areas. Dewatering of dredged sediment could be accomplished as described in Section 9.1.3. The dewatered sediment would be disposed of at one or more approved off-site facilities. Similar to contaminated soil, sediment wastes that are classified as hazardous based on the TCLP tests (assume 20%) would be disposed of at one or more off-site Subtitle C disposal facilities and the wastes that are classified as non-hazardous (assume 80%) would be disposed of at off-site Subtitle D disposal facilities.

Restoration of Areas Impacted by Slag and Battery casings and associated wastes, Excavated Areas and Dredged Areas (if necessary)

Slag Areas

Subsequent to the confirmation of the absence of source materials in the Western Jetty, seawall and source areas of Margaret's Creek, the Western Jetty and seawall would be restored to their original conditions by placement of clean rocks to match the conditions that existed prior to removal operations. In the source areas of Margaret's Creek Sector, backfilling the locations from which slag and battery casings and associated wastes are removed would not be considered necessary but may be performed if deemed appropriate. If backfilling is performed in the

Margaret's Creek areas, the clean soil used for backfilling is assumed to be transported from off-site areas tested to ensure that contamination is not present. The backfill would be covered with topsoil and revegetated, or otherwise restored to match the surface conditions that existed prior to removal/excavation operations in Margaret's Creek areas.

Soil Excavation Areas

Areas where contaminated soils were excavated would be backfilled with imported clean common fill or sand as applicable and be properly compacted. Analysis would be conducted for representative samples of the fill material to demonstrate that the fill meets applicable remediation standards and state and local requirements. After backfilling, the permeability of the excavated areas should be equal to or less permeable than adjacent areas. If necessary, locations would be re-seeded or restored to their original conditions.

Dredged Sediment Areas

All dredged areas would not necessarily require backfilling or restoration to elevations prior to dredging. However, intertidal zones in select beach areas may be backfilled with clean, imported beach-quality sand along the perimeter or as necessary based on aesthetic requirements or to match the elevations of soil backfilling. Proposed areas that would be backfilled after dredging would be finalized during remedial design. For cost estimating purposes, it was assumed that all dredged and excavated areas would be backfilled with appropriate certified clean fill material.

Permitting

Dredged material from New Jersey's coastal or tidal waters is regulated under the provisions of the following statutes: New Jersey Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.), Waterfront Development Law (N.J.S.A. 12:5-3 et seq.), Riparian Interests (N.J.S.A. 12:3-1 et seq. and 18:56-1 et seq.), Federal Water Pollution Control Act of 1972 as amended by the Clean Water Act of 1977 (33 U.S.C. § 1251), and Federal Coastal Zone Management Act (16 U.S.C. §§ 1451 et seq.) and/or other relevant statutes and implementing regulations.

The proposed dredging of sediment and disposal would meet state and local substantive permit requirements prior to construction. A detailed list would include, but not necessarily be limited to, the list found in Section 4.3.3 of the FS for the Raritan Bay Slag site.

Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Off-site Disposal of Soil and Sediment, Institutional Controls and Long-Term Monitoring

Capital Cost: \$69,000,000

Total O&M Costs: \$4,000,000

Total Present Worth: \$73,000,000

Implementation Timeframe: 2 Years

This alternative includes the following remedial components and sub-components:

- Pre-design investigation

- Removal of all source materials and contaminated soil and sediment in all areas, including:
 - Segregation and removal of slag
 - Removal of battery casings and associated wastes
 - Excavation of contaminated soils and dewatering if necessary
 - Dredging and dewatering of contaminated sediment including hot spots
- Post-removal inspection and sampling
- On-site containment of all source materials within engineered containment cells
 - Construction of engineered containment cells
 - Transportation and placement of source materials within containment cells
- Transport and off-site disposal of the removed contaminated soil and sediment
- Restoration of areas impacted by slag and battery casings and associated wastes, excavated areas and dredged areas (if necessary)
- Coastal wetlands restoration and monitoring in bay area wetlands
- Surface water monitoring
- Green remediation considerations
- Permitting
- ICs
 - Community awareness
 - Site restrictions
 - Certification of cell maintenance
- LTM of groundwater, inspection and maintenance for containment cells

In addition, five-year reviews would be conducted by EPA to ensure that the remedy is, or will be, protective of human health and the environment.

All the remedial components under this alternative except on-site containment and the LTM activities associated with on-site containment are conceptually similar in nature to Alternative 2. As summarized in Table 5-3, 11,100 CY of source materials would be contained on-site within engineered cells as part of this alternative. The volumes of soil and sediment addressed by remedial components under this alternative are the same as in Alternative 2 - approximately 81,000 CY of soil and sediment would be addressed by off-site disposal.

The IC measures and the LTM measures specific to containment cells discussed under Section 9.1 (“Common Elements and Distinguishing Features of Each Alternative”) would be implemented under this alternative. All remedial components under this alternative except on-site containment are conceptually similar to those described in detail under Alternative 2 and are not discussed separately in this section. Specific considerations related to the design and implementation of on-site containment cells under this alternative are discussed below. It should be noted that during the pre-design investigation under this alternative, geotechnical parameters including the potential for settlement would be investigated at proposed containment cell location B in addition to the pre-design investigation activities discussed under Alternative 2.

On-Site Containment within Engineered Structures

Conceptual Design of Engineered Containment Cells

General considerations with regards to construction of containment cells, placement of contaminated materials within the cells and LTM and maintenance of the cells are described in Section 9.1.2. Additional factors specific to this alternative that were considered in the conceptual design of the containment cells include:

- Volume of contaminated materials that require containment
- Availability of land space – this, along with the volume of materials contained, would determine the dimensions of the cells
- Presence of utility lines in the available areas
- Occurrence of wetland in the available areas – New Jersey Freshwater Wetland Protection Act and Wetlands Permit requirements stipulate a buffer zone of 150 feet between the wetland areas and the location of any proposed containment cell
- Load bearing capacity of the soil and potential settlement

Based on the volume estimates and above design considerations, Cell A would be located near the Western Jetty in Area 8 and would be deemed sufficient to contain the source materials from the Jetty Sector. Cell B would be located in the upland areas of the Margaret's Creek Sector (Area 8) and would be sufficient to contain the source materials from the Seawall Sector and Margaret's Creek Sector. Approximately 5,000 CY of source materials from the Western Jetty would be contained in Cell A and approximately 6,100 CY of source materials from the Seawall Sector and the Margaret's Creek Sector would be contained within Cell B. Based on the volumes and the dimensions of the cells, the maximum height of the containment cells is assumed to be approximately nine feet for Cell A near the Western Jetty and approximately eight feet for Cell B in the Margaret's Creek Sector during the preparation of cost estimates. The actual heights of the cells would be finalized during the remedial design stage.

The surficial geologic map of the site areas near containment cell locations shows that the material is mostly silt or clay and is also partially organic. This material could potentially result in settlement issues following the construction of the containment cells. The pre-design investigation would determine the load bearing capacity of the soil in the potential containment cell areas and develop engineering measures to improve the load bearing capacity of the soil to minimize settlement. Prior to construction, vibro-flotation or equivalent techniques would be utilized to minimize the occurrence of future settlement. Cell A in the Jetty Sector lies within the 100-year flood zone based on the FEMA floodplain maps. Additional engineering controls such as revetments or increasing the elevations at these cell locations would be performed to mitigate the flood hazards. The details of these mitigation measures would be finalized as part of the remedial design.

Permitting

In addition to the permits discussed under Alternative 2, EPA approval for the application of Superfund AOC policy would be required prior to placement of the source materials within containment cells. During the RI, the slag and battery casings were found to exceed TCLP limits

for lead and were classified as hazardous. Any consolidation or movement of the material would require meeting the LDR requirements, unless this consolidation is performed within the same AOC where the contamination is contiguous. Under Alternative 3, the source materials from the Jetty Sector would be placed within the containment cell in the same sector and the source materials from the Seawall and Margaret's Creek Sectors would be placed within the cells in the contiguous upland area of the Margaret's Creek Sector. In accordance with Superfund AOC policy, the source materials do not have to be treated.

Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring

Capital Cost: \$44,200,000

Total O&M Costs: \$5,600,000

Total Present Worth: \$49,800,000

Implementation Timeframe: 2 Years

This alternative includes the following remedial components and sub-components:

- Pre-design Investigation
- Capping of a selected remediation target area in Area 8
- Removal of all source materials and contaminated soil in all areas and removal of contaminated sediment in all but the capped area in Area 8, including:
 - Segregation and removal of slag
 - Removal of battery casings and associated wastes
 - Excavation of contaminated soils and dewatering if necessary
 - Dredging and dewatering of contaminated sediment including hot spots
- Post-removal inspection and sampling
- On-site containment of source materials within engineered containment cells
 - Containment of source materials, contaminated soil and sediment from Areas 7, 8 and 11 outside of the capping remediation target areas until capacity in Cell 1 near the Western Jetty
 - Containment of source materials, contaminated soil and sediment from the Seawall Sector and Margaret's Creek Sector in the on-site containment Cell 2 in the Margaret's Creek upland area
- Transport and off-site disposal of the contaminated soil and sediment remaining after containment cell capacity is reached
- Restoration of areas impacted by slag and battery casings and associated wastes, excavated areas and dredged areas (if necessary)
- Coastal wetlands restoration and monitoring in bay area wetlands
- Surface water monitoring
- Green remediation considerations
- Permitting
- ICs
- LTM of groundwater, inspection and maintenance for containment cells inspection and maintenance for cap

In addition, five-year reviews would be conducted by to ensure that the remedy is, or will be, protective of human health and the environment.

The major conceptual difference between this alternative and Alternative 3 apart from the capping component is how the contaminated soil and sediment are handled. Under Alternative 3, all removed contaminated soil and sediment from all three sectors would be disposed of at off-site facilities. Under this alternative, removed contaminated soil and sediment would also be contained within these cells until the cell capacity is reached. This cell capacity would be determined based on available land space for construction of the cells and a maximum assumed height of 15 feet for the containment cells. This assumption is made for cost estimating purposes and the actual heights of the cells would be finalized during the remedial design stage. The contaminated soil and sediment would be placed within the cells only after all the source materials are placed within the cells (i.e., none of the source materials would be disposed of at off-site facilities under this alternative). The removed contaminated soil and sediment that could not be accommodated in the containment cells would be disposed of at off-site facilities. Based on the assumed dimensions, it is expected that all the source materials soil and sediment removed from the Seawall and Margaret's Creek Sectors would be contained within the containment cell in the upland areas of Margaret's Creek.

Since a significant amount of contaminated soil and sediment would be contained on-site, the volume for off-site disposal under this alternative would be much lower than in Alternative 3. As presented in Table 5-3, under this alternative, 11,100 CY of source materials and 61,400 CY of contaminated soil/sediment would be contained on-site; 10,400 CY of contaminated soil/sediment would be disposed of at off-site facilities, and 10,400 CY of sediment would be addressed by capping. All major components under this alternative except capping have been described in detail previously as part of other alternatives. Capping and a discussion of the specific conceptual design considerations toward the determination of dimensions of the on-site containment cells are provided below.

Sediment Cap

A sediment cap would be proposed for selected remediation target area in Area 8. Two items would be paramount for the long-term effectiveness of a cap: (1) removal or control of the contaminant sources on the Western Jetty and (2) the continued presence of a coastal structure where the Western Jetty is now in order to maintain the existing conditions in Area 8. The subtidal section of Area 8 would likely be the most effective section for placing a cap. The intertidal zone would be considered for capping during the design phase. However, for this alternative, contaminated sediments in the intertidal zone are assumed to be dredged and disposed of at off-site facilities. The subtidal section of Area 8 would be approximately two acres. Likely the most effective cap would incorporate reactive media into the cap to remove dissolved metals leaching from the sediments. A conceptual design of a reactive cap is depicted in Figure 4-3a of the FS for the Raritan Bay Slag Site. In this case, a geotextile mat containing reactive materials would be placed directly over the sediments, some of which may be exposed at low tide. There would be no need to dewater the area since the cap could be installed using a barge and crane. An armoring layer would be installed over the reactive geotextile mat in order to withstand the currents and waves expected over time, and to physically isolate the

contaminated sediments. This configuration is costed as part of this alternative; however, different designs and materials would be considered during the remedial design.

Given the RAOs, cleanup levels and characteristics of the site and contaminants, a generic design was created for the purposes of the FS. The goals of the cap would be as follows:

- Slow the movement of water through the capped material
- Promote the removal of metal ions from the dissolved phase
- Promote the compaction and hardening of the contaminated sediments

Despite the adsorption of metals to clay or other materials and the potential formation of low-solubility minerals, it would be assumed for the sake of design that some fraction of the metals in the capped sediments would be dissolved in the pore water and thus prone to upward migration into the cap.

- Capping in Area 8 would include the following major components.
- Pre-design investigation, fate and transport modeling, treatability study and pilot study
- Permitting
- Design and installation
- Institutional and engineering controls
- Long-term maintenance and monitoring

Pre-design Investigation, Fate and Transport Modeling, Treatability Study and Pilot Study

The pre-design investigation would include a geotechnical evaluation, determination of expected shear stresses from currents and waves and evaluation of groundwater seepage rates. A bench-scale treatability study would be needed to identify the appropriate reactive materials, which would include a fate and transport model for the contaminants in the cap. A pilot study would be conducted to field-test the conclusions of the treatability study, as well as to test different configurations for the management of ebullition and groundwater flux.

Permitting

The proposed project would require state and local permits equivalencies prior to construction which would include, but not necessarily be limited to, the following:

- NJDEP Division of Land Use Regulation (DLUR) Waterfront Development or Coastal General Permit-Equivalency (N.J.A.C. 7:7 and N.J.A.C. 7:7E) and a Federal Coastal Zone Management Act (CZMA) consistency determination review
- NJDEP Bureau of Tidelands (N.J.S.A. 12:3)
- NJDEP Site Remediation Program – Approval by NJDEP of the Record of Decision

The above permits have been discussed under the permitting section for Alternative 2.

Design and Installation

For costing and evaluation purposes, a preliminary design of the cap was developed. The two principle layers include:

- Heavier materials such as cobbles or recycled construction debris for armoring and benthic habitat. Since this would be the layer at the sediment bed surface, it is the layer subject to cleanup levels and monitoring. For costing purposes, a rock-filled marine mattress was chosen for the armoring.
- Reactive core mat containing apatite to remove dissolved lead.

Over time, suspended sediment from the overlying water would settle onto the armoring layer and fill in the interstitial spaces. The silted-in mattress would serve to reduce the flow of seawater downward into the cap and contaminated sediments, and also provide habitat for benthic organisms. The reactive materials may lose their reactivity if they become saturated with contaminants. The cap would be reinforced when this occurs by installing a new mattress plus reactive mat system over the existing one.

The cap would be constructed by anchoring a barge near the cap area, and then hoisting the cap into place with a crane mounted on the barge. Divers and sonar would be used to guide the cap into place. Since this process could be done slowly and carefully, protective measures such as silt curtains would not be necessary.

Institutional and Engineering Controls

To protect the integrity of the cap for the long term, institutional and engineering controls would be needed to curtail access to the capped zone. These may include signs, fences and deed restrictions as discussed in detail in Section 9.1.4.

Long-term Maintenance and Monitoring

The structural integrity of the cap would be maintained in order for it to be effective. Over time as the sediments are compacted and expel pore water, the potential for the migration of contamination out of the sediments would diminish. Likewise, the generation of gas in the sediments would diminish over time as the volume of pore water decreases and organic matter is degraded. Long term monitoring would be important to ensure that the risk from the contamination has been reduced. A monitoring period of 30 years is assumed for costing purposes as discussed briefly under Section 9.1.5.

Visual inspections of the cap would be conducted twice per year for the first five years, and then annually after that for 30 years or until RAOs and cleanup levels have been consistently met. The cap would be inspected after high-energy storms such as nor'easters or hurricanes. Surface water and sediment samples would be collected during each inspection. No sediment from underneath the cap would be sampled to reduce risk of damaging the cap. It would likely be difficult to collect sufficient volume of overlying sediment considering that the top layer of the cap is proposed to be rock armoring. However, for cost estimating purposes, it is assumed that sediment would be available to collect. Sampling would be conducted concurrently with visual inspection.

On-Site Containment within Engineered Structures

General considerations with respect to the construction of containment cells and placement of contaminated materials within the cells are described in detail under Section 9.1.2. The specific factors that drive the conceptual design of the containment cells under this alternative are the same as in Alternative 3. They are as follows:

- Volume of contaminated materials that require containment
- Availability of land space - this along with the volume of materials contained would determine the dimensions of the cells
- Presence of utility lines in the available areas
- Occurrence of wetland in the available areas – New Jersey Freshwater Wetland Protection Act and Wetlands Permit requirements stipulate a buffer zone of 150 feet between the wetland areas and location of any proposed containment cell
- Load bearing capacity of the soil and potential settlement

Based on the above factors, two containment cells, one in the upland areas of Margaret's Creek Sector (Cell 2) and another near the Western Jetty (Cell 1) would be constructed. The requirements of wetland areas and the existing sewer line would impose limitations when determining the location of the cells. Since a higher volume is designated for on-site containment, the concerns due to space constraints under this alternative are exacerbated. Similarly, the concerns due to the potential for settlement are also higher due to the increased containment volume. The cell in the Margaret's Creek Sector is at a location that is partially organic silt or clay. Similar to Alternative 3, the pre-design investigation would determine the load bearing capacity of the soil in the potential containment cell areas and develop engineering measures to improve the load bearing capacity of the soil to minimize settlement. Engineering techniques such as vibro-flotation or equivalent measures would be utilized prior to construction to minimize the occurrence of future settlement.

During the remedial design when the exact locations and the dimensions of these cells are finalized, it would be verified whether they comply with the zoning regulations. Additionally, the impact of the cell in the Margaret's Creek wetlands would be evaluated in detail during the remedial design stage. Cell 1 in the Jetty Sector lies within the 100-year flood zone based on the FEMA floodplain maps. Additional engineering controls such as revetments or increasing the elevations near Cell 1 location would be performed to mitigate the flood hazards. The details of these mitigation measures would be finalized as part of the remedial design.

Under this alternative, the slag and battery casings and associated wastes, contaminated soil and contaminated sediment from the Seawall Sector and Margaret's Creek Sector would be consolidated and contained within the cells. Based on a maximum assumed cell height of 15 feet, it is expected that all removed soil and sediment from the Seawall and Margaret's Creek Sectors would be contained within Cell 2. The source materials from the Western Jetty would be consolidated and contained within Cell 1 near the Western Jetty. The contaminated soil and sediment from the Jetty Sector would then be placed within Cell 1 until the cell is filled to capacity. The remainder of the excavated/dredged contaminated soil and sediment material would be disposed of at an approved off-site Subtitle C or Subtitle D landfill similar to Alternative 2. Based on volume estimates, approximately 5,000 CY of source materials and

5,700 CY of contaminated soil and sediment would be contained in Cell 1 near the Western Jetty. The remainder of the soil/sediment from the Jetty Sector (about 10,400 CY) would be disposed of at an off-site Subtitle C or Subtitle D landfill based on TCLP results. Approximately 6,100 CY of source materials and 55,700 CY of contaminated soil/sediment from the Seawall and Margaret's Creek Sectors would be contained within the cell in the upland areas of the Margaret's Creek Sector. For cost estimating purposes, it is assumed that 20 percent of the soil and sediment for off-site disposal would be hazardous and 80 percent would be non-hazardous. The crushed battery casings that are intermingled with the soil or sediment of the Seawall Sector would also be addressed along with the soil or sediment.

Permitting

The permit equivalencies discussed under Alternative 3 would also apply to this alternative. In accordance with Superfund AOC Policy, the source materials and contaminated soil and sediment would not have to be treated when consolidated and placed in the on-site containment cells.

Alternative 5 - Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring

Capital Cost: \$47,900,000

Total O&M Costs: \$4,500,000

Total Present Worth: \$52,400,000

Implementation Timeframe: 2 Years

Alternative 5 is conceptually similar to Alternative 4 except for one change: instead of capping, sediments in the subtidal portion of Area 8 would be removed and disposed of at off-site facilities. Alternative 5 could also be considered conceptually similar to Alternative 3 except that contaminated soil/sediment would be contained on-site in addition to source materials.

This alternative includes the following remedial components and sub-components:

- Pre-design Investigation
- Removal of all source materials and contaminated soil and sediment in all areas including:
 - Segregation and removal of slag
 - Removal of battery casings and associated wastes
 - Excavation of contaminated soils and dewatering if necessary
 - Dredging and dewatering of contaminated sediment including hot spots
- Post-removal inspection and sampling
- On-site containment of source materials within engineered containment cells
 - Containment of source materials, contaminated soil and sediment from Areas 7, 8 and 11 until capacity in Cell 1 near the Western Jetty
 - Containment of source materials, contaminated soil and sediment from the Seawall Sector and Margaret's Creek Sector in the on-site containment Cell 2 in the Margaret's Creek upland area

- Transport and off-site disposal of the contaminated soil and sediment remaining after containment
- Restoration of areas impacted by slag and battery casings and associated wastes, excavated areas and dredged areas (if necessary)
- Coastal wetlands restoration and monitoring in bay area wetlands
Surface water monitoring
- Green remediation considerations
- Permitting
- ICs
- LTM of groundwater, inspection and maintenance for containment cells

In addition, five-year reviews would be conducted by to ensure that the remedy is, or will be, protective of human health and the environment.

Refer to Alternative 2 for detailed description of off-site disposal activities and refer to Alternative 4 for detailed description of on-site containment activities. As presented in Table 5-3, on-site containment addresses about 5,000 CY of source materials and 5,700 CY of contaminated soil/sediment in the Jetty Sector and 6,100 CY of source materials and 55,700 CY of contaminated soil/sediment in the Seawall and Margaret's Creek Sectors. Off-Site disposal accounts for 19,600 CY of soil/sediment in the Jetty Sector; similar to Alternative 4, it is expected that all contaminated soil/sediment in the Seawall and Margaret's Creek Sectors would be addressed by on-site containment and that there would not be a need to dispose of contaminated soil/sediment from these areas.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives discussed above were compared with the nine criteria set forth in the NCP at 40 C.F.R § 300.430(e)(9)(iii) in order to select a remedy for the site. These nine criteria are categorized according to three groups: threshold criteria; primary balancing criteria; and modifying criteria. These evaluation criteria relate directly to the requirements in Section 121 of CERCLA, 42 U.S.C § 9621, which determine the overall feasibility and acceptability of the remedy.

Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs among remedies. State and community acceptance are modifying criteria formally taken into consideration after public comment is received on the Proposed Plan. A summary of each of the criteria is presented below, followed by a summary of the relative performance of the alternatives with respect to each of the nine criteria. These summaries provide the basis for determining which alternative provides the "best balance" of trade-offs with respect to the nine criteria.

10.1 Threshold Criteria

The first two criteria are known as “threshold criteria” because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls and/or institutional controls.

Alternative 1 would not protect human health and the environment as no remedial measures would be taken.

Alternative 2 would provide the highest degree of protection to human health and the environment, as contaminated sediment, soil, slag, battery casings and associated wastes would be removed from the site, resulting in COC concentrations below the cleanup levels and the contaminated areas restored. Additionally, Alternative 2 would provide protection to the environment since all contaminated materials would be transferred to a permitted facility as compared to Alternatives 3, 4 and 5. Excavation and off-site disposal is not reversible.

Alternatives 3, 4 and 5 would be deemed less protective than Alternative 2 as improper construction, poor maintenance and significant impacts from coastal storms would affect the level of protection. These alternatives, which include slag materials contained on-site, would provide protection of human health and the environment, as long as the containment cells were properly maintained and the institutional control measures were enforced. Alternative 3 would be more protective than Alternatives 4 and 5 because a larger volume of contaminated material would be disposed of off-site under this alternative, minimizing the volume of hazardous material that would be released were the integrity of the containment cell to become compromised. Alternative 5, which includes dredging and off-site disposal of sediments in Area 8, would be more protective than Alternative 4, since this alternative includes capping in Area 8. The likelihood of the Area 8 cap being damaged by natural forces and/or due to improper enforcement of institutional controls may be significant at this location, resulting in uncovering and exposing the contamination to the receptors.

2. Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria and limitations which are collectively referred to as “ARARs”, unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or

state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provides a basis for invoking a waiver.

Alternative 1 would not comply with chemical-specific ARARs because no action would be taken.

Alternative 2 would meet the chemical-specific ARARs since contaminated sediment, soil, slag and battery casings and associated wastes would be removed and disposed of at off-site facilities. This alternative would follow hazardous and non-hazardous transportation and disposal requirements to meet the action-specific ARARs. This alternative would meet location-specific ARARs including coastal zone regulations, wetlands and floodplains regulations including restoration of coastal wetlands, wildlife habitat protection regulations and cultural historic preservation regulations.

Alternatives 3, 4 and 5 would meet the chemical-specific ARARs since contaminated sediment, soil, slag and battery casings and associated wastes above the cleanup levels would either be removed and disposed of at off-site facilities, or contained on-site.

For the slag contained on-site, these alternatives would meet chemical-specific ARARs by:

- Preventing direct contact risks via isolation of contaminants in the containment cell,
- Preventing migration of contamination from infiltration of rainwater via top liners, and
- Preventing migration of contamination to groundwater via liners at the side and bottom of containment cell.

These alternatives would meet the action-specific ARARs by following the AOC Policy requirements for on-site containment. LDR requirements would be met for materials that are disposed of at off-site facilities. These alternatives would meet location-specific including coastal zone regulations, wetlands and floodplains regulations including restoration of coastal wetlands, wildlife habitat protection regulations and cultural historic preservation regulations.

10.2 Primary Balancing Criteria

The next five criteria, criteria 3 through 7, are known as “primary balancing criteria.” These criteria are factors with which tradeoffs between response measures are assessed so that the best option will be chosen, given site-specific data and conditions.

3. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Each component of this criterion is evaluated separately below.

Magnitude of Residual Risk

The implementation of Alternative 1 would not result in decreased residual risk since no action is being taken and therefore would have no long-term effectiveness or permanence.

Alternatives 2 through 5 would provide long-term effectiveness and permanence since the contaminated materials would be removed and disposed of at off-site facilities or placed in on-site containment cells, and would no longer pose human health or ecological risk. Removal of the sources of contamination would ensure that residual contamination, if any, would be minimal and decrease over time and would be monitored to ensure attainment of cleanup goals. Coastal wetland restoration activities would mitigate any short-term and long-term impacts to the wetlands in bay areas.

Alternative 4 contains a capping component with additional factors that would limit risk reduction. Risk would be immediately reduced once installation of the cap was complete. However, capping would provide only conditional long-term effectiveness and permanence. Contaminants would be left in place that could potentially pose risks to human health and the environment if the cap was not properly maintained or if the deed notice has not been properly enforced and intrusive construction is conducted on-site that damages the cap and exposes the contaminated sediment. Furthermore, if bathymetry or hydrodynamics change over time, the cap may be eroded and expose the contamination. These changes would likely only occur if the entire Western Jetty (or its replacement) was removed. Due to the large quantity of contaminants left in place, use of the capped area would be limited. Any redevelopment would require additional remediation to be performed. Assuming the cap integrity is maintained over the long-term, the contaminated sediments under the cap would be compressed. Increased density leaves the sediment more resistant to erosion, with very slow dissolved phase contaminant migration from the sediment. This compression and consolidation would be expected to occur within the 30 year monitoring period.

Adequacy of Controls

Alternative 1 would not involve any controls and therefore would have no long-term effectiveness or permanence.

The implementation of Alternative 2 would result in the removal and off-site disposal of hazardous waste and contaminated materials and would be effective in removing site risk. The process is not reversible.

For Alternatives 3, 4 and 5, removal and disposal or on-site containment would be effective in removing site risks. The removal process would not be reversible. Long-term maintenance would be required to ensure the integrity of the containment cells. Alternative 4 would require capping and deed notices to provide adequate control of the contaminants left in place. However, routine cap inspection and monitoring could be difficult to enforce over the long term, which might result in inadequate control of site contamination.

Reliability of Controls

Alternative 1 would not involve any controls and therefore would have no long-term effectiveness or permanence

Alternative 2 would require all hazardous waste and contaminated material to be disposed of off-site, and this would be an irreversible process. Visual inspections would be performed after remedial actions to confirm that the source materials have been removed. Post-excavation/dredging sampling would confirm attainment of the cleanup levels. In addition, surface water monitoring would also be performed to confirm the contaminant concentrations do not pose unacceptable risks

For Alternatives 3, 4 and 5, post-excavation/dredging confirmation samples would be collected and analyzed to confirm that the residual contaminant levels are below cleanup levels. For containment cells, long-term maintenance, monitoring and inspection would be performed to confirm reliability of controls. For Alternative 4, the capping and deed notice required in Area 8 would provide reliable control of the contamination if properly designed, constructed, maintained and monitored over the short term.

Alternative 2 would utilize permanent solutions to the maximum extent practicable as all material above the cleanup levels would be permanently removed from the site thereby lessening the impact on the community and Raritan Bay. Removal of slag to an off-site permanent disposal facility would provide a level of permanence that on-site containment would not. Alternatives 3 and 5 would provide comparable levels of long-term effectiveness and permanence relative to each other. Alternative 4 would provide a lesser degree of long-term effectiveness and permanence due to the additional uncertainty associated with the performance of the cap.

4. Reduction in Mobility, Toxicity or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

The No Action Alternative would provide no reduction in toxicity, mobility or volume of contaminated soil, sediment, slag, battery casings or associated wastes as no remedial action would be taken.

Alternative 2 would provide no reduction of mobility, toxicity or volume through treatment at the site. It moves the contaminated materials from the site to a different off-site location where it can be better contained, hence onsite risks are eliminated or greatly reduced. For the slag, battery casings and associated wastes, dredged sediment and excavated soils that would be hazardous, reduction of toxicity and mobility would occur through treatment at a RCRA-permitted treatment/disposal facility to meet the Alternatives for LDR Treatment Standards for Contaminated Soil (40 CFR Section 286.49). Since all hazardous waste and contaminated material would be transported off-site and tested to identify whether treatment would be required, Alternative 2 would provide the greatest reduction in mobility and toxicity of the hazardous waste and contaminated material.

Under Alternatives 3, 4 and 5, removal and disposal would provide no reduction of mobility, toxicity or volume through treatment at the site. However, these alternatives would involve removal of slag, battery casings and associated wastes, contaminated soil and sediment from their currently unprotected locations to a controlled environment either on-site or off-site, hence onsite risks are reduced. The mobility of the contained wastes, either on-site or off-site, would be reduced. For the media that is hazardous and is sent off-site for disposal, reduction of toxicity and mobility would occur through treatment at a RCRA-permitted treatment/disposal facility to meet the Alternatives for LDR Treatment Standards for Contaminated Soil, 40 CFR Section 286.49. The construction of a cap that is a component of Alternative 4 would not reduce the volume of contaminants since they would be left in place. Since toxicity for metals would depend greatly on the oxidation state of the metal, a net reduction in toxicity would be uncertain. More importantly, bioavailability would be reduced since the reactive materials in the cap would remove contaminants from the dissolved phase (thus making any changes in toxicity irrelevant). The mobility of the contaminants would be reduced by preventing erosion and re-suspension of the contaminated sediments, and controlling flux of dissolved contaminants using reactive materials in the cap. Alternatives 3 and 5 are comparable when assessing reduction of mobility and toxicity. Alternative 4 would also reduce the mobility and toxicity of the hazardous waste and contaminated materials, although additional maintenance would be required to ensure these reductions. However, since each of these alternatives requires that some volume of hazardous waste and contaminated material be contained onsite and only a portion would be transported off-site and tested to identify whether treatment would be required, Alternatives 3, 4 and 5 would result in lesser reductions of mobility and toxicity than Alternative 2.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternative 1 would not have any short-term impact since no action would be taken. For Alternatives 2, 3, 4 and 5 there would be potential risks to construction workers and potentially

significant impacts to the communities during excavation/dredging, construction of the on-site containment cells and off-site disposal primarily associated with heavy equipment movements, dust and noise generation.

Alternatives 2 through 5 would all involve a significant amount of conventional construction work during removal and transport of contaminated materials. These construction activities would have some significant short-term impact to the communities and workers as well as ecological habitats. Heavy-load trucks would be driving back and forth daily in the community to transport contaminated materials and import clean rocks and other fill materials to the site. Due to off-site disposal, there would be an increased possibility of a trucking accident leading to release of materials during transport. The heavy construction equipment would generate noise. Increased particulate emissions may occur during the removal operations. Working hours would be coordinated with Old Bridge Township and the Borough of Sayreville and dust control would be implemented through the use of dust suppression techniques (e.g., water or foam sprays) to minimize impact to the local community. Storm water runoff would be controlled through the use of conventional, temporary storm water/erosion control features (e.g., berms, ditches, or silt fences). Health and safety measures would be implemented to prevent incidents and to protect the construction workers, such as using PPE to minimize exposure to contaminated materials or hazardous chemicals during remedial activities.

The fire access road in upland areas of the Margaret's Creek Sector would be heavily utilized for transportation during the off-site disposal. In order to minimize impacts due to truck traffic, all disposal activities would be coordinated with the Old Bridge Fire District and performed in accordance with the township fire regulations. Emergency plans would be followed in order to allow easy, unhindered access for fire trucks to the fire access road during fire events. If necessary, a second temporary access road may be constructed or the existing access road would be widened.

When compared to Alternatives 3, 4 and 5, Alternative 2 would require an increase in off-site traffic due to the off-site disposal of all contaminated materials. However, there is no construction of on-site containment cells under Alternative 2. Alternatives 3, 4 and 5 would not result in as much traffic on local roads as the volumes of materials disposed of off-site are lower for these alternatives. However, the onsite construction activities under Alternatives 3, 4 and 5 would be significantly greater when compared to Alternative 2, due to the construction of on-site containment cells.

Alternatives 3, 4 and 5 would include containment cells in the Margaret's Creek upland area, which would be located within a few hundred feet of both a community center which also functions as a school, as well as nearby residents. Construction would most likely result in impacts to the activities in these areas. Placement of containment cells in these recreational/residential areas could also present a sort of "attractive nuisance" to children or young adults, with the attendant potential for damage to the containment cell. Efforts to limit access to the cell through fencing are unlikely to be effective in the long term.

Due to re-suspension of sediment during dredging operations, significant adverse impact to the aquatic habitat would be expected to occur temporarily. The coastal wetlands in bay areas would

need to be restored after the remediation. To the extent practicable, areas designated for dredging would be dewatered prior to operations to avoid re-suspension. Alternatives 2 through 5 all include dredging, although the volume of sediments dredged under Alternative 4, which includes a cap in Area 8, is less than the other alternatives.

It would take approximately two years to complete the mobilization, site preparation, removal, disposal and restoration activities under Alternatives 2 through 5. Restoration of the coastal wetlands would take some additional time.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as the availability of materials and services, administrative feasibility and coordination with other governmental entities are also considered.

Alternative 1 would be the easiest to implement, as it requires no action.

Alternatives 2 through 5 include several common elements, such as dredging, excavation, and disposal, all of which are conventional remediation technologies and widely implementable. Equipment, supplies and services would be readily obtainable. Some of the difficulties associated with these technologies include:

- Dewatering the sediment, especially in areas near the Western Jetty that consist of sediment with high organic content;
- Maintaining dewatered conditions during sediment dredging operations in areas that are submerged in water;
- Accessibility of select areas in the Jetty Sector that are nearly 1,500 feet from the shore;
- Logistical issues related to transport of dredged material from the Bay to the staging area
- Difficulty in segregation of slag material from clean rocks;
- Constraints to vehicular movement in the Western Jetty and in portions of the seawall sector;
- Handling boulder-sized slag and rocks may require special attachments to standard equipment and may slow down the removal operations; and
- Lack of open space available in certain areas for the remedial operations.

Since the volume of hazardous waste and contaminated material that would be addressed by Alternatives 2 through 5 is similar, as shown in Table 5-3, these alternatives would be comparable when considering these components of the remedy.

Alternatives 3, 4 and 5 include containment cells, and services and materials for implementation would be readily available, including institutional controls such as signs and fences and environmental monitoring. Additional implementability issues specific to on-site containment cells would include potential settlement of the ground following construction of the cells and lack of space due to presence of wetland areas at the site. The former would likely be addressed by employing well established techniques such as vibro-flotation or equivalent to minimize future settlement of the ground. With regards to the latter issue, NJDEP wetland rules would allow the construction of a cell with a buffer zone of 150 feet between the cell and wetland areas.

Although land space would be available to meet these requirements, these constraints would limit the flexibility for modifications during the implementation. Alternative 2, which does not include containment, would not have to address these additional challenges.

Capping and institutional controls, which are components of Alternative 4, are established practices for sediment contamination. Equipment, supplies and services would be readily available. However, it would be difficult to implement a long-term maintenance and monitoring program and to enforce the institutional controls over the long term for the cap. The long-term maintenance and monitoring program would need to evaluate performance issues such as the settling of suspended sediments from the overlying water onto the armoring layer and fill the interstitial spaces of the cap. Since the reactive materials in the cap may lose their reactivity if they become saturated with sediments, this is particularly important to monitor. Implementation and enforcement of institutional controls for the cap would involve several agencies, including state agencies with authority over water bodies, sediment and dredging and federal agencies such as the U.S. Army Corps of Engineers and the U.S. Coast Guard.

7. Costs

Cost includes estimated capital and operation and maintenance (O&M) costs, and net present worth of capital and O&M costs.

The NCP states that "Each remedial action selected shall be cost-effective, provided that it first satisfies the threshold criteria" Cost-effectiveness is determined by evaluating the following three of the five balancing criteria noted in §300.430(f)(i)B to determine overall effectiveness: long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost-effective. A remedy shall be deemed cost-effective if its costs are proportional to its overall effectiveness." 40 C.F.R. 300.430(f)(1)(ii)(D).

Following the above requirements, EPA evaluated the overall effectiveness of the potential remedial alternatives presented in the FS by evaluating against the three criteria: long-term effectiveness and permanence; reduction in toxicity, mobility and volume through treatment and short-term effectiveness. (The modifying criteria of state and community acceptance were not used to determine cost-effectiveness of the alternatives, but were considered and responded to in accordance with NCP protocol.) EPA then compared the overall effectiveness to cost to determine whether an alternative is cost-effective. EPA compared the capital, annual operation and maintenance and present worth cost for each alternative. Of the remedial alternatives evaluated, the Selected Remedy provides the highest degree of long-term protectiveness and represents a permanent solution for the site while being cost-effective.

The estimated present worth cost for the alternatives, excluding the No Action Alternative, ranges from \$49.8 million for Alternative 4 to \$78.7 million for Alternative 2. The cost for each alternative increases as the volume of off-site disposal increases. A summary of costs can be found in Table 10-1.

Alternative 1 would not involve any cost. Alternative 2 would have the highest capital cost resulting from the transportation and disposal of hazardous waste and contaminated material,

followed by Alternatives 3, 5 and 4. Although Alternative 2 has the highest remedy cost, it provides a higher degree of long-term effectiveness and represents a permanent solution for the site. Alternative 2 would involve removal and off-site disposal of all hazardous waste and contaminated material, and this is not reversible. Alternatives 3, 4 and 5 would have a lesser degree of long-term effectiveness and permanence since these alternatives include on-site containment and, for Alternative 4, a cap. In a coastal environment, on-site containment would have a higher risk of impacts from storm events and beach erosion and would require additional maintenance should damage result from these events.

Reduction in toxicity and mobility would also be higher in Alternative 2 since all of the hazardous waste and contaminated material will be shipped offsite and would be contained at a permitted facility and treated (if these materials were determined to exceed LDR) prior to final disposal.

Alternative 2 would require an increase in off-site traffic due to the off-site disposal of all contaminated materials. However, there is no construction of on-site containment cells under Alternative 2. Alternatives 3, 4 and 5 would not result in as much traffic on local roads as the volumes of materials disposed of off-site are lower for these alternatives. However, the onsite construction activities under Alternatives 3, 4 and 5 would be significantly greater when compared to Alternative 2, due to the construction of on-site containment cells. Alternatives 3, 4 and 5 would also increase short-term impacts to ecological receptors due to the disturbances in the Margaret's Creek wetlands during the construction of the containment cells.

Based on this analysis, EPA does not consider Alternatives 3, 4 and 5 to be as cost-effective as Alternative 2 because on-site containment has lesser degree of long-term effectiveness and permanence (i.e., a higher risk of remedy failure due to storm damage at the site location), lesser reduction of toxicity (off-site disposal of all hazardous waste and contaminated material under Alternative 2 will require testing and treatment of material, as required, to reduce toxicity) and would require long-term (perpetual) maintenance of the on-site containment cells as discussed under the above evaluation criteria. EPA has determined that Alternative 2 affords the best overall effectiveness proportional to its cost.

10.3 Modifying Criteria

The final two evaluation criteria, criteria 8 and 9, are called “modifying criteria” because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.

8. State/Support Agency Acceptance

State acceptance indicates whether, based on its review of the RI/FS reports and Proposed Plan, the State supports, opposes and/or has identified any reservations with the selected response measure.

The state of New Jersey concurs with EPA's Selected Remedy as presented in this Record of Decision, as documented in Appendix F.

During the development of the FS, the USACE, New York District, which is in charge of permitting any modifications to the jetties, provided written comment opposing the use of *in situ* containment of the slag on the Western Jetty. The USACE New York District expressed concerns about the long-term effectiveness of this remedial option as well as the requirements for long-term maintenance. As a result of these concerns, the USACE New York District indicated that any permit application proposing *in situ* containment of slag on the Western Jetty would be denied.

9. Community Acceptance

Community acceptance summarizes the public's general response to the response measures described in the Proposed Plan and the RI/FS reports. The assessment includes determining which of the response measures the community supports, opposes and/or has reservations about.

The majority of comments from the community expressed its support of the Selected Remedy (removal and off-site disposal of the slag, battery casings and associated waste and contaminated material). Overall, the community did not consider Alternatives 3 through 5 to be adequately protective and opposed the use of an on-site containment remedy.

During the public comment period, comments were received from the Raritan Bay Slag Community Advisory Group (CAG), individual CAG members, Old Bridge Township and a council member, environmental groups, the PRP and local residents. The majority of the comments were supportive of EPA's Selected Remedy. Old Bridge Township issued a resolution urging EPA to proceed with the implementation of the EPA Selected Remedy.

Comments from the potentially responsible party (PRP) were in support of a containment remedy.

11.0 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

Principal threat wastes at the site include: (1) slag and battery casings and associated wastes, including particles of slag and battery casings and associated wastes identified in the soil and sediment media; (2) highly impacted soil containing particles of slag and battery casings and

associated wastes in the Seawall Sector in portions of Areas 1 and 2, in the Jetty Sector in Area 8 and in the upland portion of the Margaret's Creek Sector; and (3) highly impacted sediment containing particles of slag and battery casings and associated wastes located in Area 8 in the Jetty Sector and Areas 1 and 2 in the Seawall Sector.

12.0 SELECTED REMEDY

Based upon consideration of the results of the site investigations, the requirements of CERCLA, input from the National Remedy Review Board (NRRB), the detailed analysis of the response measures and public comments, EPA has selected Alternative 2, Excavation/Dredging, Off-site Disposal and Monitoring as the appropriate remedy for the site. All alternatives were discussed with the NRRB in March 2012 as part of the effort to evaluate an appropriate remedy for the site. The Selected Remedy presented in this ROD was selected based upon input from the state, community, USACE and the NRRB.

Construction activities associated with the Selected Remedy will be implemented in one phase over an estimated period of two years. The Selected Remedy includes the following components:

- Remediation of Slag, Battery Casings and Associated Wastes Principal threat waste (PTW) such as slag, battery casings and associated wastes will be excavated based on visual observation and disposed of at appropriate off-site facilities. Slag materials that are not readily visible will be remediated as soil/sediment. Demolition debris in the form of concrete and various bricks will also be removed and disposed of at appropriate off-site facilities.
- Surface Water By removing PTW, surface water contamination will be reduced to acceptable levels over time. Monitoring will be implemented to ensure the effectiveness of the remedy by achieving the remedial goals presented in Table 5-2.
- Soil and Sediments Contaminated soils and sediment above the lead remediation cleanup level of 400 mg/kg will be excavated and/or dredged and disposed of at appropriate off-site facilities.

RAOs for the site would be met and no ICs or five-year reviews would be required.

12.1 Summary of the Rationale for the Selected Remedy

EPA's rationale for selecting Alternative 2 is based on the following principle factors. The Selected Remedy will permanently address all PTW (slag and battery casings and associated wastes, and highly impacted soil and sediment) above the cleanup levels that were identified in a manner consistent with Agency PTW guidance, ("A Guide to Principal Threat and Low Level Threat Wastes", Publication # 9380.3-06FS, EPA, 1991). In addition, surface water monitoring will be performed for a limited time following the remedial action to confirm that there are no

increased risks due to removal activities and to verify that the remediation goals have been achieved. All slag, battery casings and associated wastes, contaminated soils and sediments including hot spot sediments in Area 5 and Area 7 above the remediation cleanup levels will be excavated and/or dredged and disposed of at appropriate off-site facilities. The slag materials and battery casings and associated wastes, dredged sediment and excavated soils that would be characterized as hazardous will be treated at a RCRA-permitted treatment/disposal facility to meet the Alternatives for LDR Treatment Standards for Contaminated Soil, 40 CFR Section 286.49.

The Selected Remedy complies with the nine criteria set forth in the NCP at 40 C.F.R § 300.430(e)(9)(iii) in order to select a remedy for the site. Section 121 of CERCLA (42 U.S.C. § 9621 (b)(1)) states that “[t]he President shall select a remedial action that is protective of human health and the environment, that is cost effective, **and that utilizes permanent solutions** ... to the maximum extent practicable.” (Emphasis added.) The Selected Remedy utilizes permanent solutions to the maximum extent practicable by removing all of the slag, battery casings and associated wastes, and soils and sediments above cleanup standards. The removal and off-site disposal process is not reversible, thereby permanently reducing contaminant levels onsite. The Selected Remedy provides long-term protectiveness by eliminating the continued leaching and migration of contaminants and the need for further monitoring of the surface water. Further degradation of the recreational waters of the Raritan Bay will be prevented by this remedy.

EPA agrees that containment remedies are appropriate in suitable locations at certain sites, where they are protective of human health and the environment; but EPA disagrees that a containment remedy is appropriate for this site given its geography and land use. Considering the coastal location of the site, alternatives that include on-site containment would not be as effective in providing permanent long-term protection as the Selected Remedy, because contamination would remain in the on-site containment cells, subject to failure, breach or damage from severe coastal storms such as those experienced by this area over the last two years, as well as the rising sea level. Although the on-site containment remedies would initially provide a level of protection to human health and the environment, at this site such a remedy has an increased risk of remedy failure due to coastal destruction. This risk is in addition to the need for continued management and maintenance of the on-site containment cells in perpetuity. Placement of containment cells in the upland location of Margaret’s Creek would situate these cells in close proximity of residential and recreational areas, and could present a sort of “attractive nuisance” to children or young adults, with the attendant potential for damage to the containment cells. Efforts to limit access to the cells through fencing are unlikely to be effective in the long term. Additionally, the administrative implementability of on-site containment alternatives is doubtful because of the strong opposition from government, residents and those who use the area for recreation.

The additional costs of these subsequent maintenance and restoration activities and such failures in protectiveness could be much higher than the cost of the Selected Remedy. It should be noted that these potential failures could include technical failures (such as damage to cell structure) as well as human exposures. These costs cannot be fully captured in the FS due to the uncertain nature of the storm events and their effects. Even though the FS provides costs for maintenance of the on-site containment cells for a period of 30 years in accordance with the EPA RI/FS Guidance, in reality the maintenance of these cells would be required for periods much longer than 30 years. The impacts of O&M to protectiveness at this site are even more significant since

the on-site containment cells are located adjacent to the wetlands and in areas that are high-risk for flooding and highly susceptible to storm damage. Containment may have been implemented at other Superfund sites but at this site where risks of failure in protectiveness are very high due to flooding, storm events, beach erosion and the rising sea level, such a remedy is not recommended.

There are only limited open spaces at the site for on-site containment, which limits flexibility in the design and placement of these cells. Since the proposed locations of these on-site containment cells occur at areas that are considered high-risk of flooding, storm events may possibly necessitate complete restoration depending on storm damage. The on-site containment cells, as proposed under the containment Alternatives 3 through 5, would likely have incurred significant damages under recent storm events such as Hurricane Irene in 2011 or Superstorm Sandy in 2012 that would have warranted significant restoration of the cells and would have likely resulted in failure of protectiveness to human health and environment.

Several leaching tests were performed during the RI using slag samples collected from the seawall sector and the Jetty sector demonstrated that the lead in slag is mobile. Data from the slag leaching tests and semi-dynamic leach tests clearly show that the lead is leachable from slag cores within a period of hours, and hence highly mobile. Additionally, the spreading of the lead contamination in the bay, beaches and the upland areas also demonstrated that lead is mobile either through leaching or weathering. Due to mechanical weathering, slag from the seawall has migrated a significant distance and would have migrated farther if not for the jetties.

Both the community and the state support the Selected Remedy, the permanent removal of contamination from the site. In addition, the USACE advocated for the removal of source and contaminated material from areas under its jurisdiction.

Based on all available information, EPA and the state of New Jersey believe the Selected Remedy provides the best balance of trade-offs among the response measures with respect to the nine evaluation criteria. EPA believes that the Selected Remedy will be protective of human health and the environment, will comply with ARARs, will be cost-effective and will utilize permanent solutions to the maximum extent practicable.

12.2 Description of the Selected Remedy

EPA has identified Alternative 2 as the Selected Remedy. This remedy provides for the removal of all PTW, soil and sediment above the remediation cleanup level. Under this alternative, slag, battery casings and associated wastes (approximately 11,100 cubic yards) and contaminated and highly impacted soils and sediment (approximately 81,000 cubic yards) above the cleanup level would be excavated and/or dredged and disposed of at appropriate off-site facilities. Surface water monitoring would be performed to confirm that there are no increased risks due to removal activities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the LDR Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. The Margaret's Creek wetland sediments would not require restoration, but

certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas.

The Selected Remedy at an estimated cost of \$78.7 million is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. The Selected Remedy will not result in contaminants remaining on the site above levels that would require restricted use. In addition, a review of the remedy will not be required every five years and the Selected Remedy will not require long-term monitoring. As stated in Section 12.1 of this document, the removal of all PTW is preferred to those alternatives with on-site containment located in a recreational area and residential community. EPA believes that the Selected Remedy would be protective of human health and the environment, would comply with ARARs, would be cost-effective and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

12.3 Summary of the Estimated Remedy Costs

Table 12- 1 includes details of the estimated costs to construct and implement the Selected Remedy. The estimated total cost to construct and implement the Selected Remedy is of \$78.7 Million. The cost estimate was developed according to "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study (EPA, 2000a)." The estimate included capital, annual operation and maintenance (O&M) and periodic costs.

It should be noted that these cost estimates are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual project cost. These cost estimates are based on the best available information regarding the anticipated scope of the remedial action. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedy

12.4 Expected Outcomes of the Selected Remedy

The Selected Remedy would be protective of human health and the environment. Risks to human health due to direct contact and ingestion would be eliminated since contaminated sediment, soil, slag and battery casings and associated wastes would be removed from the site, resulting in COC concentrations below the cleanup levels. Surface water monitoring would assess impacts from remedial activities and ensure that surface water concentrations meet acceptable levels once source materials are removed. The Selected Remedy would be in compliance with the chemical-specific ARARs since contaminated sediment, soil, slag and battery casings and associated wastes would be removed and disposed of at off-site facilities. This remedy would follow hazardous and nonhazardous transportation and disposal requirements to meet the action-specific ARARs. The Selected Remedy would also meet location-specific ARARs including coastal zone regulations, wetlands and floodplains regulations including restoration of coastal wetlands.

This alternative would provide long-term effectiveness and permanence since the contaminated materials would be removed and disposed of at off-site facilities. Coastal wetland restoration activities would mitigate any short-term and long-term impacts to the wetlands in bay areas.

Removal and off-site disposal of contaminated sediment, soil, slag and battery casings and associated wastes would be an irreversible process. Removal and off-site disposal is a conventional remedial measure and is widely implemented. The Selected Remedy will remove the contaminated materials from the site to an off-site location where it will be treated as necessary at a RCRA-permitted treatment/disposal facility to meet the Alternatives for LDR Treatment Standards for Contaminated Soil (40 CFR Section 286.49). The Selected Remedy will meet the statutory preference for treatment as a principal element. Detailed outcomes of the Selected Remedy can be found in Section 9.3.2.

Available Land Uses

The Selected Remedy will not alter the current land use at the site, which includes zoned public or vacant land with a parcel zoned for commercial use in the Jetty Sector. Land at the site will continue to be able to be used for recreational uses when the final performance standards are met.

Available Groundwater Uses

Groundwater at the site is classified by New Jersey as Class II-A with a portion of the groundwater in Area 9 as Class III-B. Groundwater is not currently used for drinking water at the site. It is highly unlikely that this situation will change because of high salinity in the groundwater and the available municipal water system which nearby residences currently use to obtain drinking water. Future potable use of groundwater in the Class III-B reclassification area is prohibited.

Groundwater did not pose any unacceptable human health risks and the beneficial use of groundwater at the site is not impacted. The active remediation at the site will prevent future migration of contaminants into the groundwater.

Final Cleanup Levels

The purposes of this response action are to mitigate human health and ecological risks posed by slag and battery casings and associated wastes, contaminated soil, sediment and surface water and to reduce the migration of contamination from the source materials.

The slag and battery casings and associated wastes contain high concentrations of lead which pose unacceptable human health and ecological risks, and act as a source of contamination for soil, sediment, groundwater and surface water. Removal of slag and battery casings and associated wastes will be by visual observation. Slag materials that are not readily visible will be remediated as soil and sediment.

Both the regulatory requirements and risk-based values were considered in the development of the cleanup levels for soil and sediment. Site background metal concentrations were also taken

into consideration in the development of the cleanup levels. Both federal and state chemical-specific ARARs for soil were identified. OSWER screening level for residential soil, New Jersey state soil remediation standards for residential and nonresidential direct contact values are considered applicable requirements in the remediation of soil at the site. New Jersey state impact to groundwater values are “to be considered” requirements. Risk-based soil and sediment cleanup levels were also developed based on the potential exposure risks for human and ecological receptors. The human health exposure pathways were evaluated for both residential and nonresidential exposures. A risk-based cleanup level was calculated using food chain models by adjusting the concentration of lead in soil until a lowest-observed-adverse-effect-level (LOAEL)-based hazard quotient (HQ) of 1.0 was achieved. The resulting cleanup level will be protective of human health and the ecological receptors (HQ=1). Lead was the only site COC identified for soil and sediment. Table 5-2 identifies the lead cleanup level as 400 ppm in soil and sediment.

Surface water is contaminated with lead and other heavy metals at the site due to erosion and from leaching of slag and battery casings and associated wastes, and contaminated soil and sediment. The results of the SLERA Addendum indicate that copper and lead were the only surface water COCs in Area 1, while lead, arsenic, copper, iron, manganese, vanadium and zinc were the COCs for Area 8. Lead in soil and sediment is the only risk driver to aquatic receptors utilizing Areas 1 and 8 and terrestrial receptors utilizing Area 9 upland areas of the site. The approach to remediating the surface water contamination at the site is to remove the principal threat wastes that act as sources of contamination to the surface water. This will reduce the surface water contamination over time to acceptable levels. Refer to Table 5-2 for detailed cleanup levels for all COCs in surface water.

All COCs shall be monitored to ensure that cleanup levels are achieved. The site is expected to be available for unrestricted land use as a result of the remedy.

Anticipated Environmental and Ecological Benefits

Information related to anticipated socio-economic and community revitalization impacts are not readily available at this time. At the completion of the construction, sampling will be performed to ensure that cleanup levels are achieved. The site is expected to be available for unrestricted land use as a result of the remedy. Anticipated ecological benefits will include removal of sources of contamination to the soil, sediment, surface water and groundwater, restoration of wetlands and beneficial use of upland areas, beaches and the bay, and protection of endangered species and aquatic and terrestrial ecological receptors. The anticipated environmental benefits may be enhanced by implementing sustainable technologies and practices in accordance with EPA Region 2’s Clean and Green Energy Policy.

13.0 STATUTORY DETERMINATIONS

As was previously noted, CERCLA Section 121(b)(1) mandates that a remedial action must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent

practicable. Section 121(b)(1) also establishes a preference for remedial actions that employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances, pollutants or contaminants at a site. CERCLA Section 121(d) further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4). The following sections discuss how the Selected Remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 2, will be protective of human health and the environment. PTW (slag, battery casings and associated wastes, contaminated and highly impacted soil and sediment) will be treated, as necessary, at a RCRA-permitted treatment/disposal facility. Removal of slag and battery casings and associated wastes, contaminated soil and sediment, will restore surface water to acceptable levels and restore the site to unrestricted use.

Risks to human health due to direct contact, ingestion and inhalation will be eliminated or greatly reduced since contaminated sediment, soil, slag and battery casings and associated wastes will be removed from the site, resulting in COC concentrations meeting the cleanup levels. As previously discussed in the risk assessments, noncancer hazards would be reduced below the remedy cleanup levels and the concentrations of COCs for surface water will be reduced to levels at or below the performance standards listed in Table 5-2. Thus, sources for future contamination will be eliminated or greatly reduced. Potential risks to wildlife and other ecological receptors will also be eliminated or greatly reduced since clean fill would be used after removing contaminated soil and sediment and clean rocks would be used after removing the slag and battery casings and associated wastes.

There are no short-term threats associated with the Selected Remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the Selected Remedy. The Selected Remedy is protective under current site use conditions and ensures future protection.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP § 300.430(f)(5)(ii)(B) and (C) require that a ROD describe federal and state ARARs that the Selected Remedy will attain or provide a justification for any waivers. ARARs include substantive provisions of any promulgated federal or more stringent state environmental standards if they exist, such as requirements, criteria, or limitations that are determined to be legally ARARs for a CERCLA site or action. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, or contaminant; remedial action; location; or other circumstance at a CERCLA site. Relevant and appropriate requirements are those that, while not legally applicable to circumstances at a particular CERCLA site, address problems or situations similar to those encountered at the site.

The Selected Remedy, removal of all slag, battery casings and associated wastes, contaminated soils and sediments above the remediation cleanup levels and surface water monitoring complies with all ARARS. The ARARS that will be met during implementation of the Selected Remedy are presented in Table 13-1.

13.3 Cost-Effectiveness

EPA has determined that the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” [NCP § 300.430(f)(1)(ii)(D)]. EPA evaluated the “overall effectiveness” of the alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The estimated present worth cost of the Selected Remedy is \$78,700,000. Although Alternative 4 at \$47,400,000 is less expensive, the Selected Remedy provides a permanent solution that allows the site to be returned to unrestricted use. EPA believes that the Selected Remedy’s additional cost for removal of all slag and battery casings and associated wastes, contaminated soil and sediments provides protection of human health and the environment and is cost-effective. The Selected Remedy is cost-effective as it has been determined to provide the greatest overall protectiveness for its present-worth costs.

13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

EPA has determined that the Selected Remedy utilizes permanent solutions and treatment technologies to the maximum extent that is practicable. The removal slag and battery casings and associated wastes, including particles of slag and battery casings and associated wastes identified in the soil and sediment and off-site disposal of highly impacted soil and sediments will permanently remove present and potential sources of contamination from the site. The Selected Remedy will ensure the continued protectiveness of the site.

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-

offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering state and community acceptance.

The Selected Remedy removes all slag and battery casings and associated wastes, and highly impacted soil and sediments through off-site disposal, resulting in COC concentrations in soil sediment and surface water below cleanup levels. The Selected Remedy satisfies the criteria for long-term effectiveness by utilizing a permanent solution with the removal of all source materials. The Selected Remedy does not present short-term risks different from the other treatment alternatives. There are no special implementability issues that set the Selected Remedy apart from any of the other alternatives evaluated, other than the requirement for complete removal of all principal threat waste.

13.5 Preference for Treatment as a Principal Element

To the extent practicable the Selected Remedy meets the statutory preference for treatment. For the slag materials and battery casings and associated wastes, dredged sediment and excavated soils that would be classified as hazardous, reduction of toxicity and mobility would occur through treatment at a RCRA-permitted treatment/disposal facility to meet the LDR Treatment Standards for Contaminated Soil (40 CFR Section 286.49).

13.6 Five-Year Review Requirements

This remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. However, since it may take more than five years to attain remedial action objectives and cleanup levels a policy review may be conducted within five years of completion of construction to ensure that the remedy is, or will be, protective of human health and the environment.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

Upon review of all comments submitted, EPA determined that no significant changes to the Selected Remedy, as it was presented in the Proposed Plan, are warranted.

Part 3

Responsiveness Summary

PART 3: RESPONSIVENESS SUMMARY

This responsiveness summary provides a summary of the significant comments and concerns submitted by the public on the U.S. Environmental Protection Agency's (EPA's) September 2012 Proposed Plan for the Raritan Bay Slag Superfund Site, and EPA's responses to those comments and concerns. A responsiveness summary is required by the National Oil and Hazardous Substances Pollution Contingency Plan at 40 C.F.R. § 300.430(f)(3)(F). All comments summarized in this document have been considered in EPA's final decision in the selection of a remedy to address the contamination at the site.

Summary of Community Relations Activities

The September 2012 Proposed Plan, which identified EPA's preferred remedy and the basis for that preference, including supporting analyses and information, was made available to the public in the administrative record file at the EPA Superfund Records Center in EPA Region 2's New York City office, the Old Bridge Central Library, Old Bridge, New Jersey and the Sayreville Library, 1050 Washington Road, Parlin, New Jersey.

The notice of availability of the above-referenced documents and the announcements of the public meeting date, time, and location was published in Middlesex County *Home News Tribune* on September 28, 2012 (see Figure 3-1). A news release announcing the Proposed Plan, which included the public information session and public meeting dates, times and locations, was issued to various media outlets on September 28, 2012. In addition, EPA emailed a flyer to area residents and other stakeholders notifying them of the availability of the above-referenced documents and encouraging participation in the public meeting.

On September 28, 2012, EPA opened a thirty-day public comment period on the proposed plan. An extension to the public comment period was requested. As a result, it was extended to November 27, 2012. On October 17, 2012, EPA held a public meeting at the George Bush Senior Center, Old Bridge, New Jersey to inform local residents and officials about the Superfund process, to present the preferred remedial alternative for the site, to discuss the Proposed Plan, and to listen to and respond to questions and comments from area residents and other interested parties. A total of over 80 people attended the public meeting including residents, local merchants, representatives of the media, state and local government officials, and other interested parties.

In addition, the site has an active Community Advisory Group (CAG) which was formed in September 2010 and is comprised of sixteen local residents, one local official and representatives of Edison Wetlands Association, NY/NJ Baykeeper, Riverkeeper and one congressional office representative. This group generally meets monthly and has provided input to EPA throughout the remedial investigation and feasibility study process. These meetings are open to the public and representatives from local, state and federal elected officials have attended as have other interested stakeholders.

Selected Remedy Overview

EPA's selected remedy includes, among other things, excavation/dredging and off-site disposal. Slag, battery casing and associated wastes and contaminated and highly impacted soils and sediment above the cleanup level would be excavated and/or dredged and disposed of at appropriate off-site facilities. Surface water monitoring would be performed to confirm that there are no increased risks due to removal activities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the LDR Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas.

Summary of Comments and Responses

Over 24 comment letters were received via email and U.S. mail during the comment period from September 28, 2012 through November 27, 2012. Copies of the comment letters are provided as a separate attachment to this Record of Decision. Following is a summary of the significant comments contained in the letters and the comments provided at the public meeting of October 10, 2012, as well as EPA's responses to those comments. Because the purpose of this Responsiveness Summary is to respond to significant public comments submitted on EPA's preferred remedy for the Site, this Responsiveness Summary does not address comments that raised funding- or liability-related issues concerning implementation of the ROD.

A copy of the transcript from the public meeting is available in the Administrative Record, which is available at the information repositories identified above. A copy of the transcript can also be found in Appendix D.

Comments were received from various groups and individuals, including the CAG and individual CAG members, the Township of Old Bridge and an individual Council member, environmental groups, local residents and a potentially responsible party. The majority of comments were supportive of EPA's Selected Remedy (Alternative 2, Excavation/Dredging, Off-site Disposal and Monitoring). Old Bridge Township also issued a resolution urging EPA to proceed with implementation of the Selected Remedy. Comments from the potentially responsible party (PRP) were in support of a containment remedy. A summary of these comments grouped under common topics and EPA's responses follows.

General

Comment 1 A commenter has indicated that the discussion of site history in the proposed plan is incomplete and should be expanded.

EPA Response: The ROD and Proposed Plan are intended to inform the public of the scope and extent of the contamination at an NPL site, identify the remedial options evaluated which address that contamination and identify the selected remedial action(s) and the legal and technical bases for that selection. The proposed plan and the ROD provide sufficient detail for the public to

understand how the site came to be, the nature and extent of contamination, and how the remedy was selected.

Comment 2 One resident indicated that munitions have periodically washed up on the beachfront by Bayview Drive and that these incidents can be confirmed with the Old Bridge bomb squad.

EPA Response: The issue of munitions is not a component of the site or the remedy. The occasional presence of munitions washing up on the beach should be reported to the township for appropriate handling and disposal.

Comment 3 The commenter requested financial assistance for local businesses impacted by the cleanup.

EPA Response: The Superfund law does not contain a provision to provide financial assistance to business impacted by the cleanup.

Site Investigation and Characterization

Comment 4 A commenter asked what time of year did EPA perform the (Characterization of Hydrodynamics and Sediment Dynamics) study.

EPA Response: The Characterization of Hydrodynamics and Sediment Dynamics was conducted from December 1, 2010 to January 5, 2011.

Comment 5 A commenter asked where the Technical Review Workgroup (TRW) composite samples were collected; whether in the bay itself or in the Margaret's Creek area.

EPA Response: The TRW composite samples were collected from Areas 2, 3, 5 and 6.

Comment 6 A commenter believed that a quantitative estimate of the mass of contaminated soils and sediments that will be excavated to achieve the remediation goals should be provided in the Record of Decision (ROD).

EPA Response: Table 3 of the Proposed Plan provides the site breakdown of the remediation volumes of different media such as source materials, soil and sediment. The corresponding locations are illustrated in Figure 3 of the Proposed Plan. In addition, Table 2 of the Proposed Plan summarizes the volumes of each media type that would be addressed under remedial approaches such as off-site disposal or on-site containment under each alternative. The locations and their corresponding remedial approach under each alternative are illustrated in Figures 3, 4 and 5 of the Proposed Plan. These volumes by remedial component are included in Table 5-3 of the ROD.

Comment 7 A commenter stated that the designation of the site source materials as a "Principal Threat Waste" is erroneous, misleading and is arbitrary and capricious.

EPA Response: EPA believes that designating the source materials as principal threat wastes is consistent with the EPA guidance document on principal threat wastes. This guidance defines principal threat waste as “those source materials considered being highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.” The NRRB, whose function is to review remedies for consistency with national guidance and policy, agreed with the characterization of this material as principal threat waste. (NRRB correspondence to Walter Mugdan, dated July 5, 2012, page 7.)

Based on the concentrations of lead in the slag and the toxicity characteristic leaching procedure (TCLP) analysis from the slag, it is clear that the source materials are highly toxic. It appears that the commenter also agreed that there are significant quantities of soil and sediment at the site which are toxic and are classified as hazardous waste. While the comment states that the materials can be reliably contained, it ignores the fact that the contamination has spread to the bay, beaches and upland soil, and also that the contamination would present a significant risk to human health and environment should exposure occur. Hence, it is appropriate to designate the source materials and some of the soil and sediment which exhibit high levels of lead as principal threat wastes.

Comment 8 A commenter indicated that EPA’s implication that the slag poses a leaching risk if contained on-site is erroneous and misleading. The commenter asserted that lead in the slag is not highly mobile and the primary (if not only) transport mechanism of lead in the slag to soils and sediments is mechanical weathering by wave action over an extended period of time. The commenter stated that when crushed slag particles were subjected to the synthetic precipitation leaching procedure (SPLP) leachate test (intended to mimic seawater) and the de-ionized water (DIW) leachate tests, lead did not leach at levels that were even detectable.

EPA Response: The DIW and semi-dynamic leach (SDL) tests performed for EPA clearly demonstrated that lead and other metals leach from both intact slag samples and crushed slag samples. Lead concentrations in the leach water using the crushed slag samples and DIW ranged from 30 to 170 milligrams per liter (mg/L). Leaching tests using intact core samples (SDL tests) resulted in lead concentrations in the leachate of up to 0.57 mg/L. The RI report discusses these leaching results in detail in Section 5.3.2. The interpretation of the leaching tests and the differences among the leach tests and actual field conditions are also discussed in Sections 5.3.3 and 5.3.4, respectively of the RI report. Section 5.3.4.5 of the RI report discusses the overall applicability of the leaching tests to field conditions. This section concludes that concentrations similar to those measured in the SDL tests could be observed in the field for water interacting with intact slag. Concentrations similar to those measured in the DIW tests could potentially be observed in the field for water interacting with smaller eroded slag particles. As discussed in these sections of the RI report, many conditions affect actual concentrations in the field. Even though weathering and erosion of particulates is the primary pathway of the release of metals into environment, lead and others metals do leach from the slag and leaching is a secondary pathway for the release of metals into the environment from the primary sources.

Comment 9 A commenter has identified perceived flaws in sampling methodologies. The commenter suggested that EPA’s surface water and groundwater sampling was flawed, failed to

follow basic sampling guidelines, and referenced the six surface water samples collected in 2008 as an example of the flawed techniques. As a result, the ability of the state and community to make informed comments has been impeded by EPA's reliance on flawed data and misleading information.

EPA Response: Surface water samples obtained in 2008 from 22 locations in the Seawall Sector and Jetty Sector may have been collected using methods inconsistent with later sampling rounds collected during the RI in 2010 and 2011. Field filtering prior to preservation was not documented in the field logbooks for these 2008 samples. Failure to field filter may lead to unrepresentative dissolved metals concentrations. Therefore, the surface water dissolved metals results from the 2008 samples discussed in the RI Report may be biased high.

The six locations from the 2008 sampling were collected using "activity-based" methods, whereby sediment at the sampling location was intentionally re-suspended by the sampler prior to surface water sample collection. Since sediment re-suspension is common in Raritan Bay due to waves and currents, activity-based sample results were not discussed separately in this RI. This information was included in the errata sheets for the RI report and is available in the Administrative Record for the site.

Dissolved surface water results in 2008 were not used in the development of preliminary remediation goals (PRGs) or to guide any remedial decisions. Surface water data were considered in the initial screening of contaminants against surface water values protective of ecological receptors. Surface water data were not used in the food chain exposure modeling due to the estuarine nature of the water. As the determination of risk to upper food chain receptors was used to derive the PRGs, surface water data were not considered in this calculation. In addition, only total metals samples were used in the human health risk assessment and there were no surface water pathways identified driving the human health risk at the site.

EPA does not agree that the absence of dissolved metals in grab samples collected from this dynamic system demonstrates that the slag does not leach. The presence or absence of metals in surface water is just one line of evidence in the evaluation of the leaching pathway; further evidence, from more controlled, laboratory studies, is discussed in response to Comment 22.

Surface water will be monitored during and after implementation of the Selected Remedy to assess surface water quality. Once the source material has been removed, it is expected that surface water will meet ARARs.

Groundwater sample results collected for EPA in 2010 and 2011 are depicted in Figure 1-21 of the FS report. The protocols implemented in the field for groundwater sample collection are in accordance with EPA's procedures and the approved Quality Assurance Project Plan (QAPP). EPA believes that the methodology implemented in the field is valid and applicable for use in the RI/FS. EPA has determined that groundwater does not present an unacceptable risk to human health and the environment. Therefore, EPA does not believe that further groundwater data are needed at this time to characterize groundwater.

Comment 10 A commenter indicated that EPA has significantly underestimated the volume and cost of material that would have to be shipped to a hazardous waste landfill under the total off-site disposal alternative. The commenter also believed the FS assumes that only 20 percent of the materials are hazardous.

EPA Response: EPA believes volumes and costs of material have been adequately characterized and estimated. Investigation-derived wastes (IDWs) collected from contaminated areas during the RI were characterized as nonhazardous waste. The commenter has also misinterpreted the assumption in the FS. All source materials (100 percent of slag and battery casings and associated wastes) were assumed to be disposed of off-site as hazardous materials. The 20 percent assumption applied only to contaminated soil and sediment at the site.

EPA has further evaluated the nature and locations of the samples that exceeded TCLP results. Some of the soil and sediment samples that showed very high concentrations of lead did so due to the presence of weathered slag particles that were present along with the contaminated soil/sediment. Additionally, they occurred at locations that were in close proximity to the source areas (seawall, western jetty) or depositional areas. This is clear from Figure 2 (showing the proximity of sample locations to seawall) and Photograph 2 (showing weathered slag particles present in the collected sand) of Appendix B (final slag characterization report by Schnabel) of the FS report. Hence, the sample results referenced by the commenter represent some of the highest soil concentrations of lead encountered at the site and cannot be considered to represent typical lead concentrations for the purpose of disposal. Also, some of the samples referenced in the June 2009 report (Summary letter to Nick Magriples June 2009) which was part of the second phase of the Integrated Assessment, appear to be from locations atop the slag in the western jetty/seawall and hence should be considered as source material and not soil samples.

For the above reasons, EPA believes that by following proper segregation practices during stockpiling after excavation, the volume of materials that would be classified as hazardous can be significantly reduced (these details would be finalized during remedial design). Hence, EPA believes that the volume and cost of materials are reasonable and have not been underestimated as stated in the comment.

Remediation Goals

Comment 11 A commenter indicated that the unified remediation goal of 400 parts per million (ppm) for lead is inconsistent with the new Jersey Department of Environmental Protection (NJDEP) acute sediment screening value of 210 ppm for ecological risk.

EPA Response: EPA believes that the use of sediment screening values should not be used as remediation goals. Screening values are intended to be used only for the purpose of screening concentrations of chemicals detected in site media. The initial screening exercises conducted during the Screening Level Ecological Risk Assessment (SLERA), and subsequently the SLERA Step 3a, included the NJDEP marine sediment effects range-low (ER-L) and effects range-medium (ER-M) values for lead of 47 mg/kg (milligram per kilogram) and 218 mg/kg, respectively. The NJDEP acute sediment screening value was not used in the SLERA. This is consistent with the typical approach to screening: as the analysis proceeds further, the screening

becomes more refined and site-specific. The sediment lead cleanup level of 400 mg/kg was calculated via food chain models using site-specific sediment and tissue data. Use of these values in establishing cleanup goals is representative of the site, and carries fewer assumptions and less uncertainty than use of an acute sediment screening value.

Comment 12 A commenter noted that the selected remediation goal of 400 ppm for lead, which is based on the allowable blood lead concentrations of no more than 10% of the population having a blood lead level greater than 5 micrograms per deciliter (ug/dl), is of concern, since current literature suggests that this value should and may be lowered.

EPA Response: The remediation goal of 400 ppm for lead is protective of public health. As the Center for Disease Control (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) continue to evaluate health effects and blood lead levels and EPA will monitor those discussions. However, it should be noted that the relationship between lead concentrations found at the site is very complex and that a reduction in target blood levels does not necessarily suggest that a commensurate reduction in the lead remediation goal would be necessary. U.S. EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) is tracking ongoing discussions within the Agency and at the CDC before making any policy decisions related to soil lead exposures and lead risk assessment. In the interim, OSRTI's current (U.S. EPA 1998 <http://www.epa.gov/superfund/lead/products/oswer98.pdf>) soil lead policy applies.

Comment 13 A commenter asserted that EPA should adopt a risk-based cleanup standard for lead that is based on an appropriate depth.

EPA Response: The cleanup goal for lead identified in this remedy is health-based. A unified cleanup goal was developed for this site due to the dynamic environment. Tidal currents regularly move and redistribute soils and sediments, resulting in an ongoing mixing of these media. These actions also may result in soils at depth being uncovered, which makes them available for exposure. In addition, the impact of storm surge and beach erosion also influences how soils and sediments are transported at the site and made available for direct contact exposure. For these reasons, EPA identified a health-based unified cleanup goal for lead that will be applied to both soils and sediments at all depths.

Comment 14 A commenter indicated that EPA should consider a remedy that includes the use of slag containment features to increase storm protectiveness and erosion control. The commenter has asserted that EPA has failed to examine appropriately *in situ* treatments that would potentially minimize volume and toxicity of excavated soils and sediments.

EPA Response: The EPA considered the approach of using slag containment features to increase storm protectiveness and erosion control early in the development of the FS. The results of this effort indicated that this approach was not viable and was not included as an alternative. For the Western Jetty, EPA discussed this possibility in June 2011 with the U. S. Army Corps of Engineers (USACE) NY District, which has jurisdiction over the jetty. USACE NY District officials indicated they would not approve the proposed jetty alternative that leaves the slag in-place and encapsulates the jetty with concrete or grout. They are concerned that the concrete/grout would deteriorate over time because of the saltwater environment and wave

action. They conclude that macroencapsulation would result in unacceptable long-term risks and maintenance obligations.

The seawall is not under USACE NY District jurisdiction. Nonetheless, the USACE NY District's reasons for rejecting this proposal at the jetty also apply to the seawall: with waves and saltwater (especially during storms), the macroencapsulation could deteriorate and eventually re-expose slag to the elements.

In situ treatment would not be effective in treating the boulder-sized hazardous slag as the treatment would require reduction of the slag size followed by treatment with cement. Such a crushing operation to reduce the slag size would be a highly intensive effort. The solidification/stabilization process would also increase the total weight of waste materials for disposal substantially, thereby increasing the transportation costs significantly. These operations would require a large open area at the site, which is lacking. Even if such operations could be sited, they would generate a significant amount of dust and extremely loud noise which are highly inappropriate for a residential/recreational area and would receive strong opposition from the local community. Finally, the cost saving from disposal in a Subtitle D landfill may not be sufficient to offset the on-site treatment cost.

For the remainder of the hazardous contaminated soil/sediment, on-site treatment operations would be highly difficult to implement due to space limitations, multiple mobilizations and multiple types of operations (excavation/dredging, transfer, crushing, treatment) that would need to be performed simultaneously. This would have a significant impact on cost and schedule. It would be more cost-effective and easier to perform such treatment at the disposal facilities, which are generally better equipped to handle treatment operations. Although the transportation distance may be reduced, the number of trucks arriving and leaving the site to dispose of the soil and sediment would be the same or greater, due to the additional volume associated with application of the treatment agent.

Comment 15 A commenter requested EPA to consider mechanical separation techniques (i.e., soil washing, gravity separation and magnetic separation) that could be used to reduce the volume of impacted soils and sediments that must be addressed at the site. The goal would be to save costs by rendering the slag-impacted soil and sediment-, nonhazardous so that it can be shipped to a local landfill, or enable it to achieve the cleanup level thereby eliminating the need for off-site disposal. The commenter also indicated a willingness to perform treatability studies to determine the effectiveness of the technologies in achieving the cleanup level and/or rendering the slag impacted soil and sediment to become non-hazardous wastes.

EPA Response: The EPA considered the following mechanical separation techniques described below.

Soil washing would only be effective for contaminants that can be dissolved into solution. It would not be effective for soil and sediment contaminated or impacted by slag and battery casings, as the slag and battery casing would not be dissolved.

Magnetic separation depends on the ability of the magnet to attract the slag particles that contain iron. As a result, it would not be effective for the battery casings and associated wastes as these wastes do not contain iron. A field test performed on the slag showed that only a portion of the slag exhibited magnetic attraction. As a result, magnetic separation would only be partially effective as a separation process. Additionally, it is uncertain if this technology can render the slag-impacted soil and sediment to nonhazardous waste or enable it to meet the cleanup goal.

Gravity separation could be effective in removing large slag particles but would be difficult in removing the fine fractions. Again, the degree of effectiveness is unknown. Additionally, the applicability of this technology for battery casings and associated wastes is questionable.

Based on the discussion above regarding the technology limitations, it is likely that a treatment train using multiple technologies would be required in order to achieve the goals. The commenter failed to offer any success stories or case studies specific to lead in slag that can demonstrate the effectiveness of these technologies.

The biggest problem EPA foresees with these technologies is their implementability, both technical and administrative. The limited space available at the site makes such operations extremely difficult to implement. Mechanical separation is a messy and noisy operation, requiring a lot of equipment and occupying a large footprint. The treatment requires multiple handling of the materials, resulting in dust generation. It also requires ample space to store the treated and untreated materials in piles. At the end, it is unclear if this would ultimately result in cost savings as the additional operations may offset the cost saved from the reduced disposal volumes. It is also likely that the treated soil and sediment may still require off-site disposal in a Subtitle D landfill. Therefore, the treatment may not save as much money as expected.

On-site treatment will extend the construction completion schedule by as much as one year. This does not include the additional time required for bench- and pilot-scale treatability studies.

On-site treatment could have significant short-term impact to the community (noise, dust, traffics, stock piles, schedule extension, etc.) and will receive strong opposition from the community. Administratively, it is not implementable.

Selected Remedy

Comment 16 Many comments were received from various groups and individuals, including the CAG and individual CAG members, the Township of Old Bridge and an individual Council member, environmental groups and local residents in support of EPA's Selected Remedy (Alternative 2, Excavation/Dredging, Off-site Disposal and Monitoring). Old Bridge Township also issued a resolution urging EPA to proceed with implementation of the Selected Remedy.

EPA Response: Comment noted.

Comment 17 A commenter asserted that the Selected Remedy does not meet the criterion of cost-effectiveness as required by the NCP.

EPA Response: The NCP states that "Each remedial action selected shall be cost-effective, provided that it first satisfies the threshold criteria ...". Cost-effectiveness is determined by evaluating the following three of the five balancing criteria noted in §300.430(f)(i)B used to assess overall effectiveness: long-term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost-effective. A remedy shall be deemed cost-effective if its costs are proportional to its overall effectiveness." 40 C.F.R. 300.430(f)(1)(ii)(D).

Following the above requirements, EPA evaluated the overall effectiveness of the potential remedial alternatives presented in the FS by evaluating the alternatives against the three criteria: long-term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment and short-term effectiveness. EPA then compared the overall effectiveness to cost to determine whether an alternative is cost-effective. EPA compared the capital, annual operation and maintenance, and present worth cost for each alternative. Of the remedial alternatives evaluated, EPA believes the Selected Remedy provides the highest degree of long-term protectiveness and represents a permanent solution for the site while being cost-effective. See also Response to Comment 14 and Section 10.2 of the ROD for a detailed analysis of the "cost-effective" criterion.

Comment 18 A commenter asserted that the Selected Remedy and on-site containment "are equally protective" and therefore "cost should be the tiebreaker."

EPA Response: EPA believes that the Selected Remedy and the on-site containment alternatives do not provide the same degree of protection to human health and the environment, given the site's geographic location. The Selected Remedy provides a significantly higher degree of long-term effectiveness than alternatives which include on-site containment of hazardous waste and contaminated media. Each of the containment alternatives would involve creation of one or more containment cells in areas that are in close proximity to ecologically sensitive wetlands and the bay coastline, areas prone to flooding and destruction during storm events. The containment cells would also be located very close to residential areas and in close proximity of areas that are used for recreation by children and adults. The Selected Remedy, in contrast, would remove the source of contamination to a more stable location, specifically designed and operated for secure containment of contaminated materials. Additionally, materials that failed the TCLP testing would be treated, further reducing toxicity.

Given the situation of the containment cells at the site's coastal location, Alternatives 3, 4 and 5 would not provide the same degree of overall protection as the off-site removal provided by Alternative 2. The fact that the contaminated media would remain on-site, and would continue to be subject to severe coastal weather events and would need to be managed and maintained in perpetuity makes a significant difference. These circumstances have been considered in the Evaluation of Alternatives section of the Proposed Plan. EPA believes that, for this site, it would be more cost-effective to address the slag and contaminated soil and sediment at one time rather than incur potential future costs from storm damage and the perpetual management of the containment on-site. Furthermore, there is limited land available for containment cell that is not prone to flooding and storm erosion at a site which includes ecologically sensitive areas, has nearby residential development in close proximity of areas used for recreation by children and

adults. EPA believes one potential containment cell area, namely upland of Margaret's Creek, would have a significant impact on the community. At this location, there is a community center, which is used daily as a school and would be only a few hundred feet from a potential containment cell. During construction of the containment cell the impacts to the school, adjacent residential areas and nearby wetlands would be significant. Ensuring the long-term integrity of containment cells near residential and recreational areas also presents concerns. The cells would be mounds that would likely attract exploration by children and young adults. Attempts to limit access (i.e., through fencing) would not only be inconsistent with the character and value of the surrounding natural area, but would likely be ineffective.

Based on the preceding discussion, EPA believes removal of the slag waste from the coastal environment provides a level of permanence that alternatives involving on-site containment do not. There are existing off-site disposal facilities which can reliably accept and manage the waste in compliance with their operating permits. EPA does not believe that an on-site containment remedy and the Selected Remedy are equally protective; thus, considering "cost" as a tie-breaker is not warranted.

Comment 19 A commenter suggested the Selected Remedy will have substantial negative short-term impacts not adequately considered by EPA.

EPA Response: EPA believes the FS has evaluated the short-term impacts of all alternatives appropriately and adequately. The selected remedy would include a significant amount of conventional construction work during removal and transport of contaminated materials. These construction activities would have some significant short-term impact to the communities and workers such as truck traffic, noise, dust, and use of the fire access road in upland areas of the Margaret's creek sector which would be heavily utilized for transportation during the off-site disposal. In order to minimize impacts due to truck traffic, all disposal activities would be coordinated with the Old Bridge Fire District and performed in accordance with the township fire regulations. Emergency plans would be followed in order to allow easy, unhindered access for fire trucks to the fire access road during fire events. If necessary, a second access road may be constructed or the existing access road would be widened.

The heavy construction equipment would generate noise. Increased particulate emissions may occur during the excavation activities. Working hours would be coordinated with Old Bridge Township and the Borough of Sayreville and dust control would be implemented through the use of dust suppression techniques (e.g., water or foam sprays) to minimize impact to the local community. Storm water runoff would be controlled through the use of conventional, temporary storm water/erosion control features (e.g., berms, ditches, or silt fences).

It should be noted that with the exception of the No Action alternative, all alternatives have these same short-term impacts. Indeed, alternatives that rely on containment cells would have additional construction-related impacts in close proximity of residential/recreational areas. The risks to on-site workers and nearby residents and community members under all of the alternatives will be mitigated by following appropriate health and safety protocols, by exercising sound engineering practices, and by using proper protective equipment.

Comment 20 A commenter suggested that EPA did not fully assess “sustainability” in the Selected Remedy. The commenter also asserted that the use of biofuels would increase the cost of the Selected Remedy.

EPA Response: Section 9.1, Common Elements and Distinguishing Features of Alternatives, Green Remediation Considerations, provides a detailed discussion of sustainability for the Selected Remedy as well as for Alternatives 3, 4 and 5. Considerations for the Selected Remedy identified that the major energy consumption for Alternative 2 would be fuel used by construction equipment and vehicles, commutation to the site by workers, and transportation for importing clean rocks/fill and for off-site disposal of contaminated sediment, soil, slag and battery casings and associated wastes. Fuel efficient vehicles and equipment and biodiesel fuel would be used to the extent possible. Work sequence and trip planning would be implemented to minimize the work duration and number of trips. Water use under this alternative would be minimal, primarily for dust control and decontamination. Remediation would restore the contaminated land to beneficial use.

In addition, the commenter fails to mention that the use of biofuels would also increase not only the cost for the Selected Remedy but also the costs for Alternatives 3 through 5 to a similar degree.

Comment 21 A commenter asserted that off-site disposal of slag and other material is twice as expensive as on-site containment but is equal to off-site disposal in overall protectiveness. For that reason, the Selected Remedy does not comply with the “cost-effectiveness” requirement of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The commenter stated that EPA must consider and adopt a remedy that places as much of the slag and other material as possible in an on-site containment unit, and consider other techniques to reduce costs. The commenter also asserted that remedies including on-site containment are fully protective of human health and the environment, comply with all ARARs, satisfy the long-term effectiveness and permanence criterion, meet toxicity/volume/mobility reduction objectives to the same degree as the Selected Remedy, are fully implementable and that operation and maintenance of an on-site containment area does not impact the protectiveness of an on-site containment remedy.

EPA Response: EPA believes that the Selected Remedy complies with all selection criteria. Section 121 of CERCLA (42 U.S.C. § 9621 (b)(1)) states that “[t]he President shall select a remedial action that is protective of human health and the environment, that is cost-effective, **and that utilizes permanent solutions** ... to the maximum extent practicable.” (Emphasis added.) EPA agrees that containment remedies are appropriate in suitable locations at certain sites, where they are protective of human health and the environment; but EPA disagrees that a containment remedy is appropriate for this site given its geography and land use.

The Selected Remedy utilizes permanent solutions to the maximum extent practicable by removing all of the slag, battery casings and soils and sediments above cleanup standards. The removal and off-site disposal process is not reversible, thereby permanently reducing contaminant levels on-site. The Selected Remedy provides long-term protection to human health

and the environment by eliminating the continued leaching and migration of contaminants and the need for further monitoring of the surface water. Further degradation of the recreational waters of the Raritan Bay will be prevented by this remedy. Excavation and off-site disposal provided by the Selected Remedy reduce toxicity, mobility or volume through treatment for any hazardous wastes to meet the Resource Conservation and Recovery Act (RCRA) Land Disposal Requirements. A detailed evaluation of how the Selected Remedy complies with all of the criteria can be found in the Decision Summary, Sections 12.0 and 13.0.

Given the coastal location of the site, alternatives that include on-site containment would not be as effective in providing permanent long-term protection as the Selected Remedy, because contamination would remain in the on-site containment cells, subject to failure, breach or damage from severe coastal storms such as those experienced by this area over the last two years. Although the on-site containment remedies would initially provide a level of protection to human health and the environment, at this site such a remedy has an increased risk of remedy failure due to coastal destruction. This risk is in addition to the need for continued management and maintenance of the on-site containment cells in perpetuity. Placement of containment cells in close proximity of residential/recreational areas could present a sort of “attractive nuisance” to children or young adults, with the attendant potential for damage to the containment cells. Efforts to limit access to the cells through fencing are unlikely to be effective in the long term.

The Selected Remedy provides the highest level of long-term effectiveness and permanence. The additional cost of the Selected Remedy, which is 58 percent higher than the least expensive alternative, is outweighed by the higher degree of long-term effectiveness and permanence it provides over the other alternatives, thereby satisfying the cost effectiveness criteria of Section 121 of CERCLA.

Addressing the remaining criteria, protection of the environment is a threshold criterion of the NCP that must be met. Removal of the slag and lead-contaminated media to a location prepared, managed and proven to be able to accept and contain the contamination, advances this criterion to a higher degree than on-site containment cells located in very close proximity to wetlands and within 50 feet of the bay in the Western Jetty area, and in areas used for recreation adjacent to residential areas.

Regarding compliance with ARARs, improper or inadequate maintenance or external conditions (such as storm damage in high-risk flooding zones) could cause failure to comply with ARARs. Even though the alternatives which include on-site containment would be in compliance with ARARs under normal conditions, the risks of failure to comply are high with on-site containment alternatives, for the reasons discussed above.

Regarding implementability, this includes both technical and administrative feasibility of implementing an alternative. Although there are some technical challenges to implementation (as noted in the FS), the on-site containment alternatives are technically implementable. However, the on-site containment remedies do not provide reduction of toxicity, mobility or volume through treatment. Additionally, the administrative implementability of on-site containment alternatives is doubtful because of the strong opposition from government, residents and those who use the area for recreation.

For these reasons, EPA has determined that the Selected Remedy meets the criteria more effectively than any of the alternatives.

Comment 22 A commenter suggested that operation and maintenance (O&M) of an on-site containment area would not impact the protectiveness of an on-site containment remedy.

EPA Response: Based on the detailed and comparative analysis provided in the FS, the O&M of the on-site containment cells significantly impacts the protectiveness. O&M, including long-term monitoring would be necessary for Alternatives 3, 4 and 5 because contaminated materials would remain on site following the implementation of the remedy. Long-term monitoring would include periodic surface water and/or sediment sampling and analysis, in order to monitor contaminant concentrations over time in the vicinity of on-site containment cells or in-situ cap. This would be necessary to: identify any potentially toxic and/or mobile transformation products, assess the effectiveness of remedial action implemented, verify that the extent of contamination is not expanding downgradient, laterally or vertically, verify no unacceptable impact to potential receptors, detect new releases of contaminants to the environment or migration of existing contamination that could impact potential receptors, to demonstrate the efficacy of institutional controls that were put into place to protect potential receptors, and to verify attainment of RAOs.

In addition, periodic inspections and maintenance activities would be performed for the on-site containment cells and/or the in-situ cap. Periodic inspections of containment structures and monitoring of surrounding groundwater conditions around the containment structures would be performed to: ensure that the cell or cap is successfully mitigating contaminant migration, confirm that the cell or cap is effective in reducing any current or future risks of exposure to acceptable levels and assess if repairs or additional remedies are necessary. The monitoring activities would also involve periodic inspections of the area to assess erosion and to confirm the structural integrity of the containment cell or cap, checking for proper drainage (for containment cells) or damage (for containment cells and cap) post storm events, and periodic groundwater monitoring in the downgradient vicinity of the containment cell in order to ensure effectiveness of containment.

As noted above, the presence of containment cells in close proximity of residential/recreational areas is likely to attract attention from children and young adults, whose activities can compromise the integrity of the containment, imposing additional maintenance costs while potentially enabling exposure to contaminants until maintenance work is completed. (Fencing to limit access to the cells is not only inconsistent with the natural and recreational character of the area, but is unlikely to be effective over the long term.)

For the foregoing reasons EPA believes that O&M activities do impact the protectiveness of an on-site containment remedy.

On-site Containment

Comment 23 Many of the commenters raised the concern that if a remedy were selected in which the contaminated materials were contained on-site, then this remedy would not be protective of human health and the environment.

EPA Response: During the planning of the FS, EPA considered a variety of remediation strategies and technologies. Each of these needed to meet the threshold criteria of protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs), in order to be evaluated more fully. All remedies included in the FS, discussed in the Proposed Plan and presented at the public meeting meet these threshold criteria and would be protective of human health and the environment. However, for the reasons set out above, EPA determined that the long-term protectiveness of off-site disposal is significantly greater and more reliable than that of the other alternatives considered.

Comment 24 A commenter asserted that on-site containment is fully protective of human health and the environment. The commenter expressed three opinions that on-site containment alternatives, which include Alternatives 3 through 5, are equally protective of human health and the environment as the Selected Remedy. The three opinions are: 1) lead is not highly mobile and has not migrated far from the location where it originally was deposited, and the principal transport mechanism is mechanical weathering; 2) containment systems are routinely used on Superfund sites and there are a variety of mechanisms to ensure isolation of the materials; and 3) the locations of the on-site containment cell proposed in Alternatives 3 to 5 would not be heavily impacted by even the most severe storm surges the area has experienced.

EPA Response: Several leaching tests performed during the RI using slag samples collected from the seawall sector and the jetty sector demonstrated that the lead in slag is mobile. Data from the slag leaching tests and semi-dynamic leach tests clearly show that the lead is leachable from slag cores within a period of hours, and hence is highly mobile. The presence of lead contamination in the bay, beaches and the upland areas also demonstrated that lead is mobile either through leaching or weathering.

EPA agrees that on-site containment systems have been implemented successfully in suitable locations at appropriate Superfund sites. This site, however, is significantly less amenable to such a remedial approach due to the high risk of flooding and storm damage that may result in contaminant migration. Although engineering measures can potentially limit the damages from storm events to containment areas, they cannot entirely eliminate them or the potential for failures over the long term due to severe storm events. Additionally, the more robust the containment structure is made, the more inappropriate it becomes for this natural area adjacent to residential and recreational areas. For example, a concrete bunker could be designed that might withstand most storms, but that would dramatically increase the cost and be entirely inconsistent with the character and uses of the area.

There are limited open spaces available at the site for on-site containment. Since the proposed locations of these on-site containment cells would be in areas that are at high-risk of flooding and coastal erosion, storm events may necessitate significant or even complete restoration depending on the extent of the storm damage. The on-site containment cells, as proposed under Alternatives 3 through 5, likely would have sustained significant damages from recent storm events (Superstorm Sandy in 2012), which would have warranted significant restoration of the cell(s) to maintain protection of human health and the environment.

It appears that the commenter did not take into account the location of all the containment cells that would be necessary to implement Alternatives 3 through 5. Based on the impacts from recent hurricanes in these areas, these locations would likely have been significantly impacted and the cells damaged. There is a general consensus in the scientific community that storm events will occur more frequently and be more severe in the future in the New York/New Jersey area. On-site containment cells, therefore, would be highly susceptible to future damage.

It should also be noted that the damage due to Superstorm Sandy, although significant, was limited because of the direction of the storm surge near the site. In contrast, there were coastal areas nearby (such as Staten Island) where the storm surge effects occurred nearly a mile inland from the shore. This may have occurred at the site had the Superstorm Sandy taken a different course and made landfall at the site during high tide. The potential on-site containment cell area near the Western Jetty was inundated with flood water and sustained erosion damage during Superstorm Sandy. Had an on-site containment cell been located there, the structural integrity of the containment cell may have been compromised requiring reconstruction, evaluation and remediation of any contamination released from the containment cell.

Comment 25 A commenter indicated that EPA has overstated the cost of on-site containment by incorrectly including costs for ground improvements when no such measures are likely to be required.

EPA Response: Both EPA and the commenter are reviewing limited data to derive their opinions, given the absence of detailed geotechnical data for subsurface soils. Nonetheless, both parties agree that settlement could occur; the difference is in the degree of settlement to be reckoned with in evaluating remedial alternatives. EPA's approach and assumptions regarding ground improvements are more conservative than those of the commenter, and appropriately so. Based on the surficial geologic cross section map (Figure 1-5 of the FS), it is clear that some of the areas designated for on-site containment cell construction occur on top of estuarine deposits consisting mostly of organic clay, silt and peat. Given the nature of these deposits, there is the potential for settlement and/or differential settling that may lead to structural failure of the cells. For this reason, EPA has adopted the conservative assumption that ground improvements would be required. The estuarine deposits underlying the site are susceptible to extensive, uneven settlement. In the absence of deep geotechnical borings in the area has necessitated a conservative estimate for ground improvements is warranted and appropriate.

Remedy Implementation

Comment 26 Several comments were received that asked for specific details on the preferred remedy, including information of the duration of the project, access to the beach during the remedial action, how debris will be addressed and how impacts to marine habitats could be minimized.

EPA Response: The specific details of EPA's preferred remedy will be developed during the remedial design. The information presented in the FS is based on high-level, conceptual designs that allow EPA to choose the remedy that best meets the nine criteria. Once EPA has selected a final remedy for the site, the remedial design will begin. This will include working with all involved parties, including the local communities and the CAG, to develop a plan to implement

the remedy in an effective and efficient manner. Issues such as access to the beach, debris disposal and impacts on marine habitats will be addressed at that time.

Comment 27 The commenter expressed concern that the low-cost bidder for cleanup will not do a sufficient cleanup job and disrupt the surrounding area.

EPA Response: The implementation of the remedy will be overseen by EPA. All work associated with the remedy implementation will be done in accordance with an approved remedial design in order to ensure the work is done properly while minimizing disruption to the surrounding area to the degree practicable.

Comment 28 A commenter asserted that EPA's revised FS should have included a phased/OU alternative focusing first on removal of primary source material.

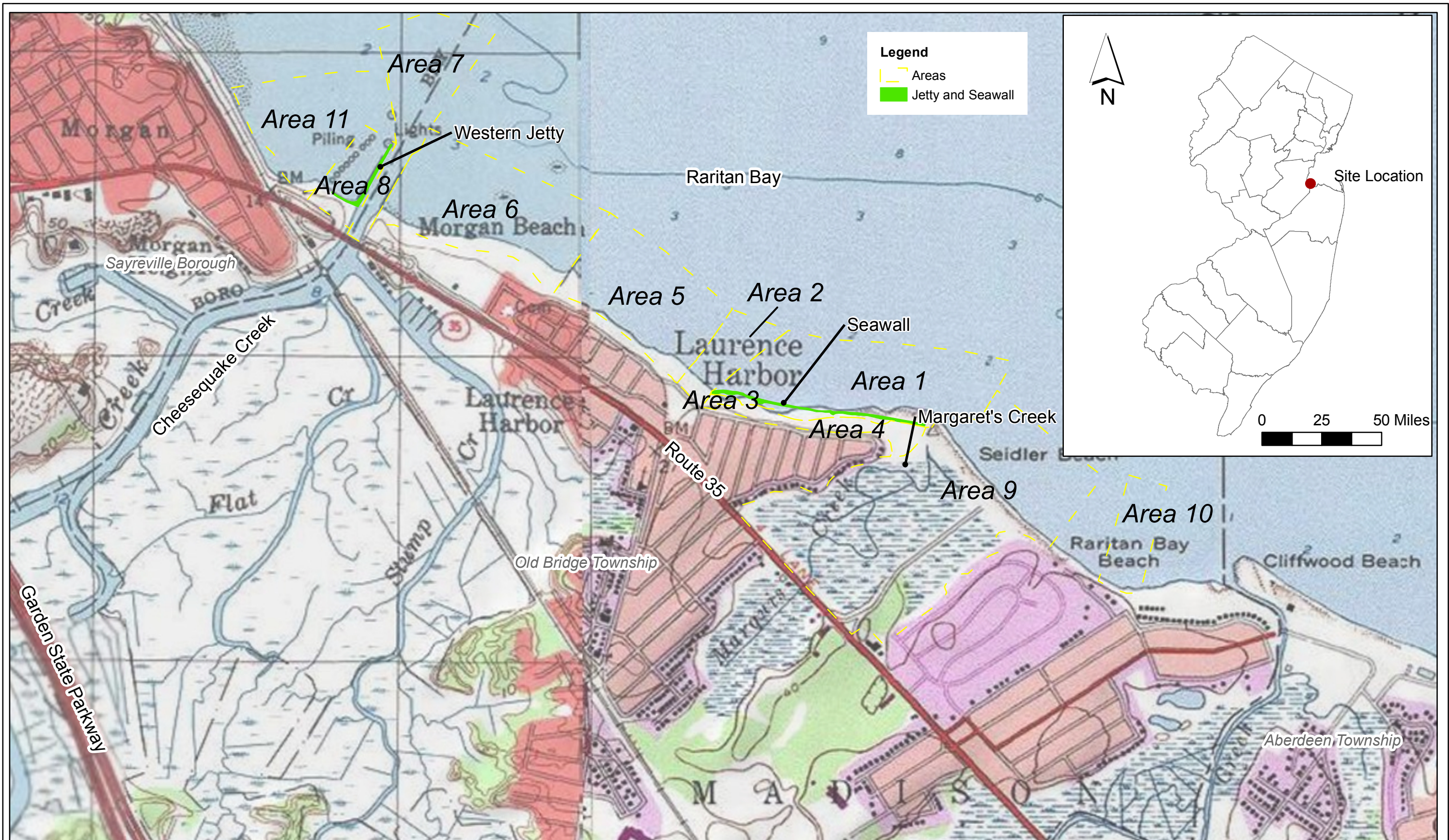
EPA Response: It is EPA's goal to complete all remedial actions as efficiently and cost-effectively as possible, while minimizing short-term impacts to the community. During design, the strategy for implementing the various components of the remedy will be developed. An added constraint that has already been demonstrated has been the effects that storms can have on the redistribution of the contaminated media. Based on the long-shore currents of the tide, the implementation of the remedy must be sequenced in a specific order.

Institutional Controls

Comment 29 The National Remedy Review Board's (NRRB) comments and Region 2's responses should include a discussion of Institutional Controls (IC) required for the various alternatives considered. The commenter believes that the Proposed Plan is not clear because it says "total removal" should have no IC. The ROD must specifically state no ICs are required, or if there could be ICs associated with the Proposed Plan, the specifics of those ICs and their bases must be clearly stated.

EPA Response: In the Proposed Plan, the sixth paragraph under the "Common Elements" subsection of the "Summary of Remedial Alternatives" section clearly states "... institutional controls (ICs) such as a deed notice or restrictive covenant would be required for portions of the site as one component of maintaining the long-term protectiveness of all alternatives with the exception of Alternative 2." The ICs are addressed in Section 4.3.1.1 of the FS report and Section 9.1, Institutional Controls of the ROD.

APPENDIX A – Site Figures



Source: USGS Topographic Quadrangle

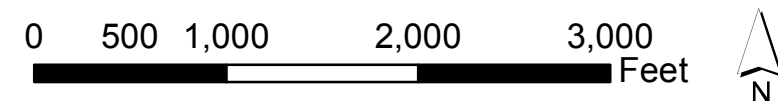


Figure 1-1
Site Location Map
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey



Seawall Sector	Area 1: Laurence Harbor Seawall	The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
	Area 2: Laurence Harbor Beach	The beach area at the foot of Laurence Parkway between the western end of the seawall and the first jetty.
	Area 3: Laurence Harbor Playground	The park playground adjacent to the western end of the seawall.
	Area 4: Old Bridge Waterfront Park	The park area along the seawall (not including the playground) from the fence to the roadway.
	Area 5: Laurence Harbor Beach	The beach area between the first and third jetty.
	Area 6: Laurence Harbor Beach	The beach area between the third jetty and Cheesquake Creek Inlet eastern jetty.
Jetty Sector	Area 7: Cheesquake Creek Inlet	The inlet between the eastern and western jetties from the Route 35 Bridge into Raritan Bay to the extent of sediment deposition.
	Area 8: Cheesquake Creek Inlet Western Jetty	The jetty and adjacent subtidal area west of the inlet in Sayreville.
	Area 11: Western Extent	The extent of the site west of Area 8.
Margaret's Creek Sector	Area 9: Margaret's Creek	The wetlands and upland areas associated with the Creek (between the beach and Route 35), including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
Background Area	Area 10: Background Area	The historical background sampling location.

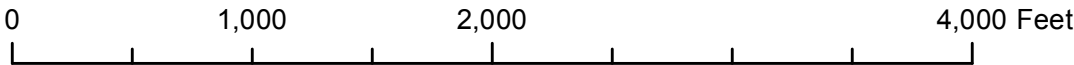


Figure 1-2
Investigation Areas
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, New Jersey

Figure 3-1

PATH rail fare to rise to \$2.25 a trip

By Larry Higgs
@APFerry

Riders of the PATH train between New Jersey and New York will need an extra quarter to get through the turnstiles starting Monday morning.

Fares on the interstate rapid transit line operated by the Port Authority of New York and New Jersey will increase to \$2.25 per trip at 3 a.m. Monday, which is the second phase

of a toll and fare increase package approved by the authority in August 2011.

The second phase of the increase at Hudson River bridges and tunnel tolls to \$15 for drivers of passenger cars who pay cash will take effect Dec. 2, Port Authority spokesman Ron Marisco said.

PATH riders have been alerted through social media, email alerts, the "PATH Vision TV system and posters, Marisco said.

Both the PATH system and the bridges and tunnels offer a discount for electronic toll and fare payment. PATH riders who use the PATH Smart Card get a discount to a one-way fare of \$1.70. Cash customers and those using Metrocards will pay full fare.

Drivers who use E-ZPass also receive a discount depending on whether they are traveling in peak or off peak hours.

Dwelling sits at heart of community, holiday

Rabbi Eliezer Zaklikovsky (left) of the Chabad Jewish Center of Monroe and volunteer Stan Edelman of Monroe place bunnies on the roof of a sukkah, a hut of temporary construction that is used for the duration of the autumn Sukkot festival.

For seven days and nights, a special blessing is recited and all meals are eaten in the sukkah.

The Sukkot holiday starts at sundown on Sunday.

LARRY FRANK /
STAFF PHOTOGRAPHER



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY INVITES PUBLIC COMMENT ON THE PROPOSED PLAN FOR THE RARITAN BAY SLAG SUPERFUND SITE OLD BRIDGE AND SAYREVILLE, NEW JERSEY

The U.S. Environmental Protection Agency (EPA) announces the opening of a 30-day comment period on the preferred plan to address slag, battery casing/associated wastes, contaminated soils and sediments at the Raritan Bay Slag Superfund site in Laurence Harbor/Sayreville, New Jersey. The preferred remedy and other alternatives considered are identified in the Proposed Plan.

The comment period begins on September 28, 2012 and ends on October 29, 2012. As part of the public comment period, EPA will hold a public meeting on Wednesday, October 17, 2012 at 7:00 p.m. at the George Bush Senior Center, 1 Old Bridge Plaza, Old Bridge, New Jersey.

The Proposed Plan is available electronically at the following address:
<http://www.epa.gov/region02/superfund/rpl/raritanbayslag/>

Written comments on the Proposed Plan, postmarked no later than October 29, 2012 may be emailed to Mitchell.Tanya@epa.gov or mailed to Tanya Mitchell, US EPA, 290 Broadway, 19th Floor, New York, New York 10007-1966.

The Administrative Record files are available for public review at the following information repositories:

Old Bridge Central Library
1 Old Bridge Plaza
Municipal Center
Old Bridge, NJ 08857
Hours: Monday - Friday 9:30 AM - 9 PM
Saturday 9:30 AM - 5 PM, Sunday 12:30 - 5 PM

Sayreville Library
1050 Washington Rd.
Parlin, NJ 08859
(732) 727-0212
Hours: Monday - Tuesday 9:30 AM - 7:45 PM
Friday and Saturday 9:30 - 4:45 PM, Sunday 1 - 4:45 PM

Laurence Harbor Library
277 Shoreland Circle
Laurence Harbor, N.J. 08857
Hours: Monday, Wednesday, Thursday and Saturday 1:00 PM - 5 PM
Tuesday, 1:00 pm - 5:00 PM, Closed Sunday

USEPA Region 2, Superfund Records Center, 290 Broadway, 18th Floor, New York, New York 10007-1966

Please contact Pat Seppi, EPA's Community Involvement Coordinator, at 212-637-3679 for more information.

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COLONIA \$269,900 IT EXCEEDS YOUR EXPECTATIONS and then some you'll love the Country Club. This is a rare find! 1001 sq ft, 4 bedrooms, 3 bathrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths. Now is the time to buy.	CARTERET \$218,000 AMAZING! UNBELIEVABLE! A great location for a family home! This is a rare find! 1001 sq ft, 4 bedrooms, 3 bathrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths. Now is the time to buy.	SAYREVILLE \$1,050 RENT A FAMILY PLACE! Beautifully built 4 bedrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths, 2 bedrooms, 2 full baths, 2 half baths. Now is the time to buy.

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MEET FACE-TO-FACE WITH THOUSANDS OF HOMEOWNERS
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Figure 3 - 1
E-Tear Sheet from AD
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

EPA

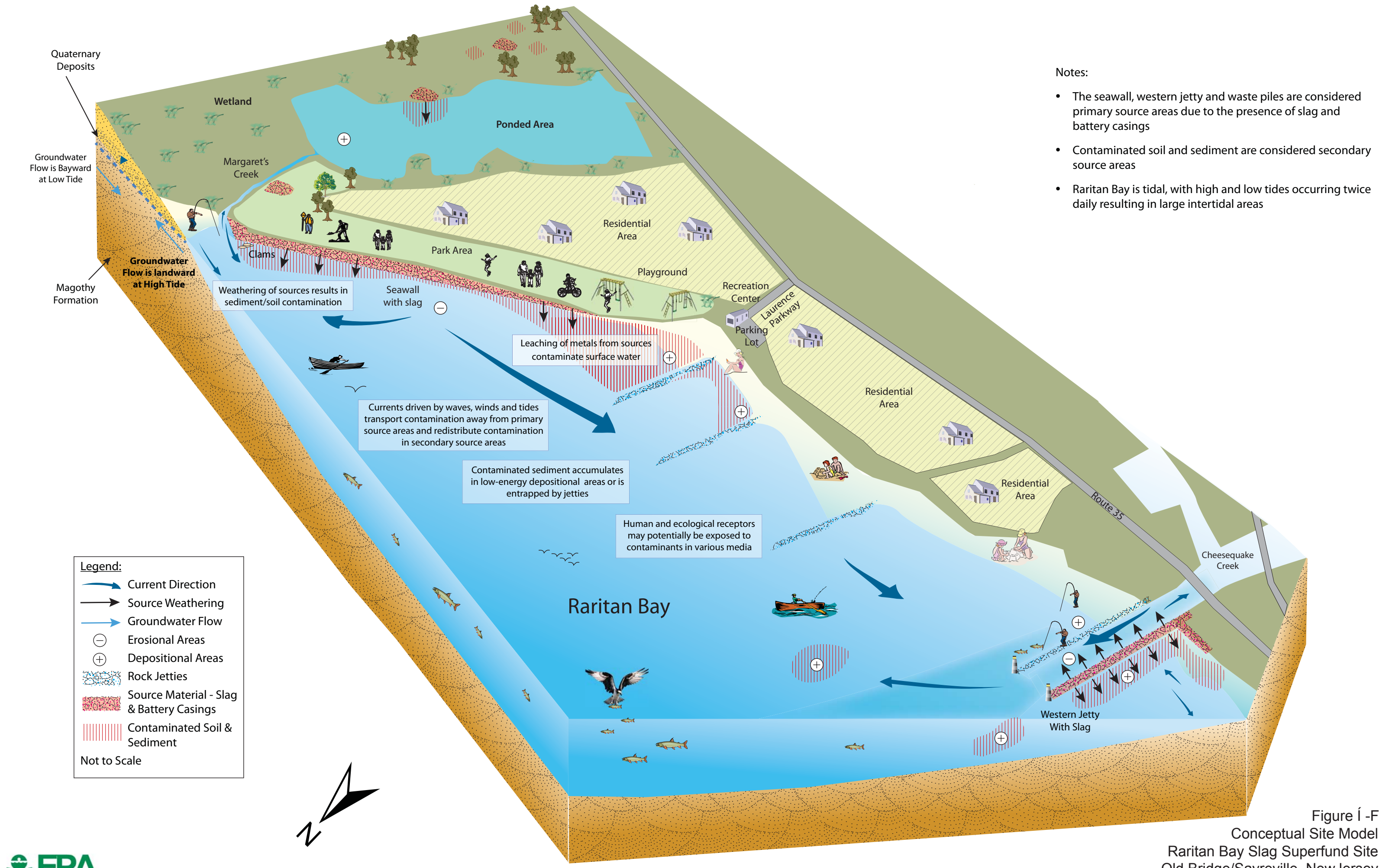
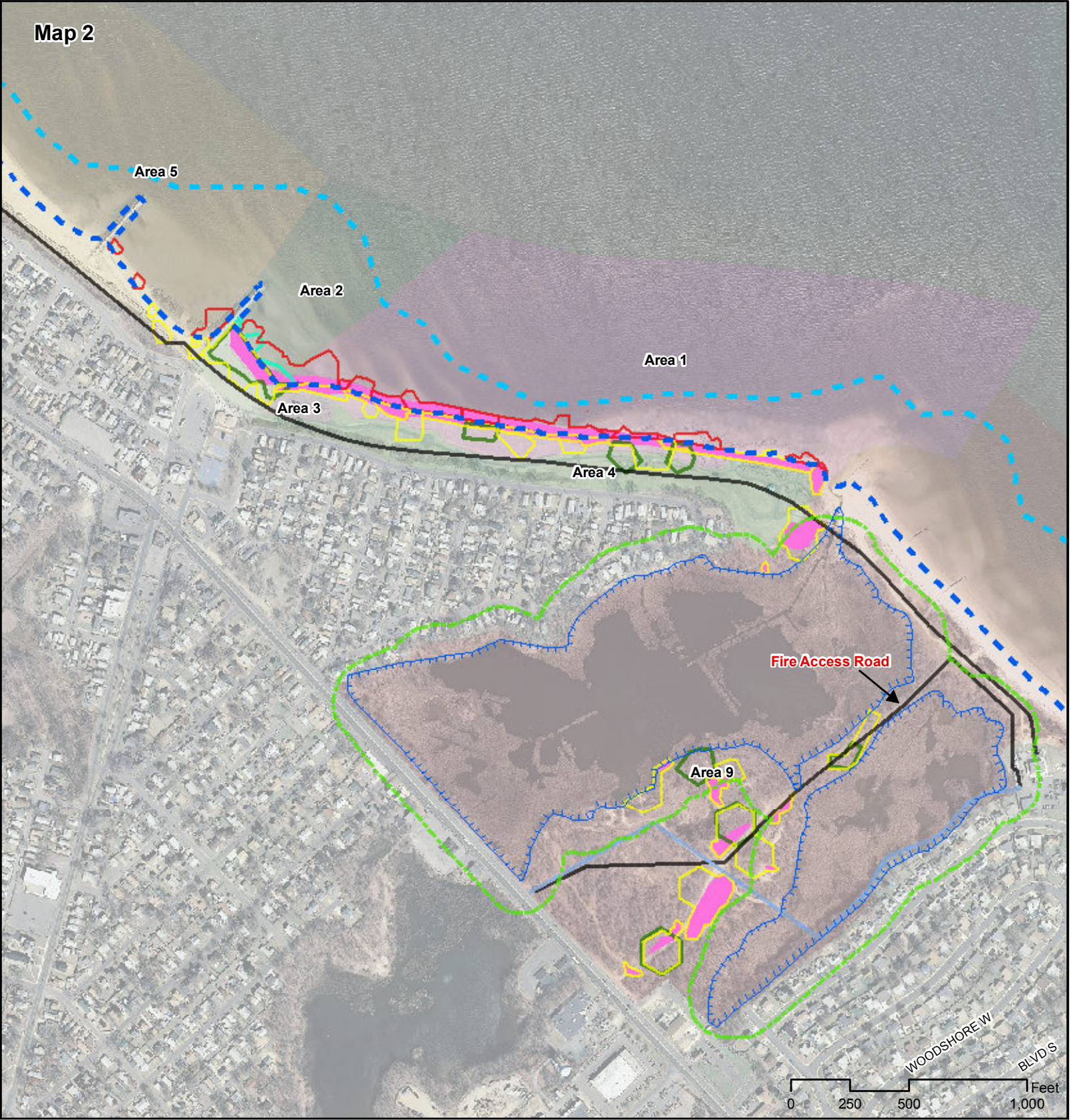
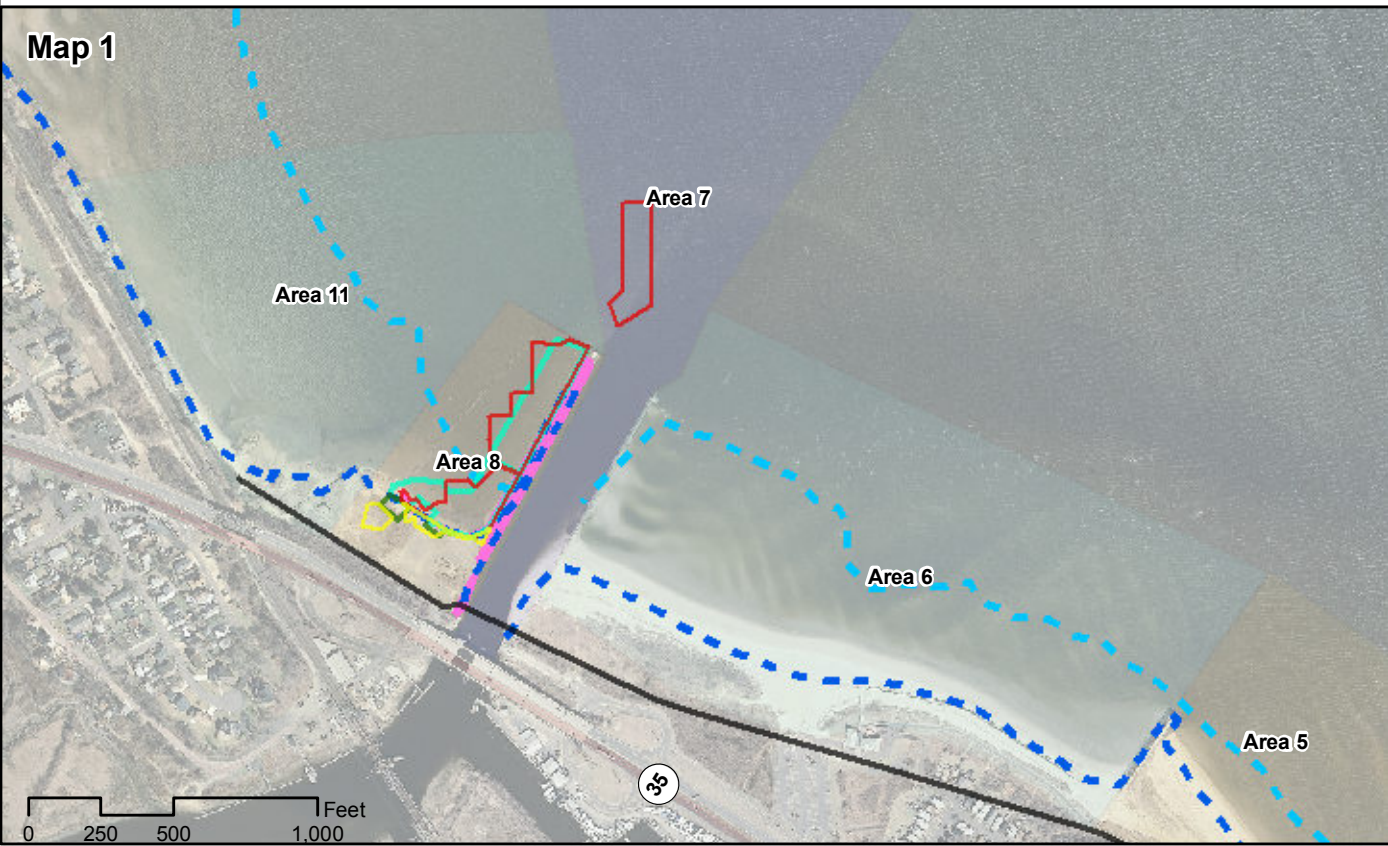
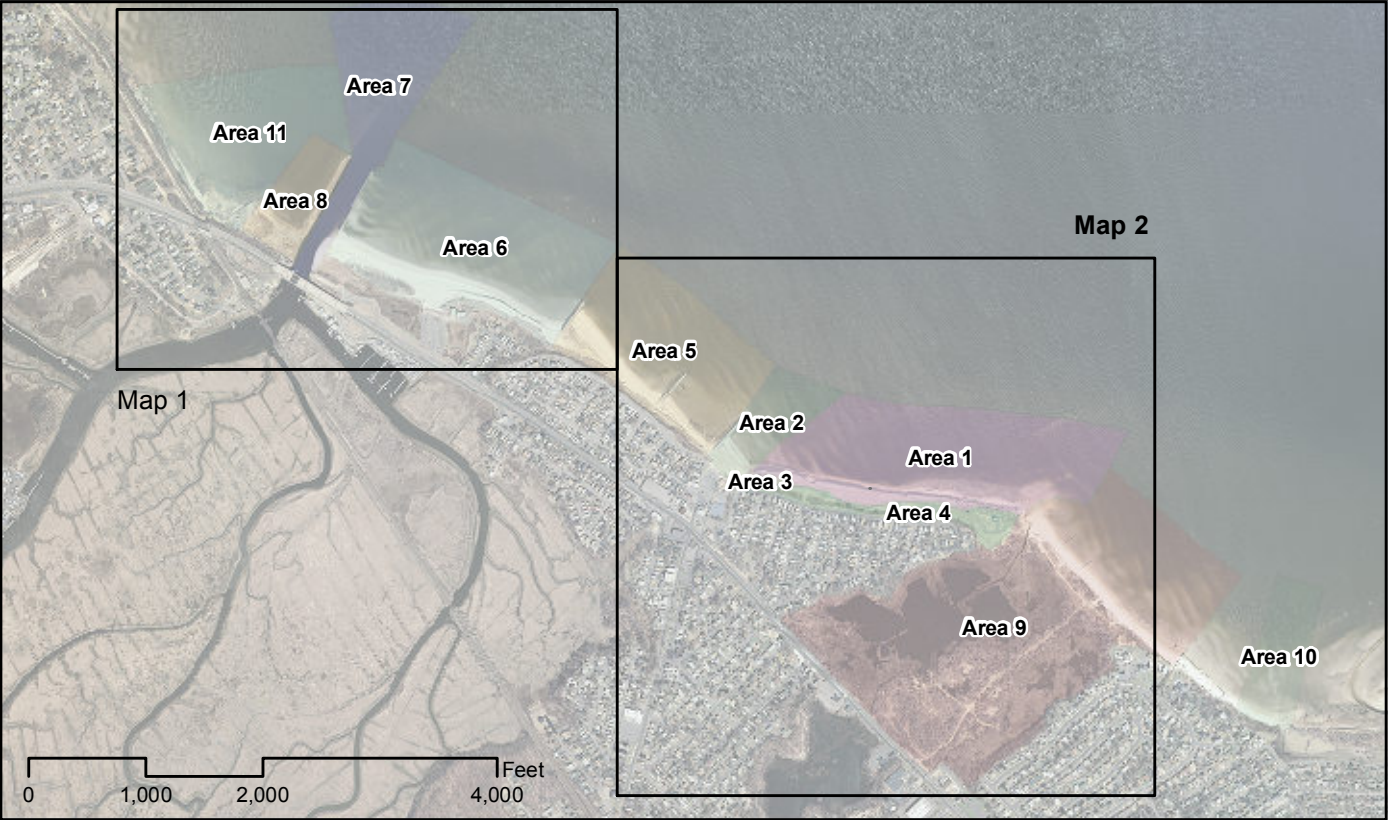


Figure 1-F
Conceptual Site Model
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey



Legend

- | | |
|---|--|
| Surface Remediation Target Area | |
| Surface Soil | Existing Sewerline |
| Surface Sediment | Abandoned Sewerline |
| Subsurface Remediation Target Area | |
| Subsurface Soil | Mean high tide line |
| Subsurface Sediment | Spring low tide line |
| Soil/Sediment Demarcation Line | Wetlands and wetland transition zone (estimated) |
| | Slag and Battery Casings/Associated Wastes |

1. Remedy consists of removal and off-site disposal of contaminated materials, and monitoring of surface water.
2. The slag and battery casings/associated wastes will be removed from the areas shown and disposed of to Subtitle C landfill.
3. The contaminated soil will be excavated and disposed of to Subtitle D or Subtitle C landfill based on the TCLP test results.
4. The contaminated sediment will be dredged, dewatered and disposed of to a Subtitle D or Subtitle C landfill based on the TCLP test results.
5. The existing sewerline is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

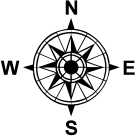


Figure 12-1
Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey



APPENDIX B – Tables

Table 5-1
Summary of Volume Estimates
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

	Source Materials Volume	Source Materials Weight	Soil Volume, CY			Soil Weight	Sediment volume, CY			Sediment Weight	Total Volume	Total Weight
	Cubic Yards	Ton	Surface	Subsurface	Total	Ton	Surface	Subsurface	Total	Ton	Cubic Yards	Ton
Jetty Sector												
Area 7	-	-	-	-	-	-	3,136	-	3,136	5,331	3,136	5,331
Area 8	4,994	21,474	1,036	464	1,500	2,250	8,386	12,237	20,623	35,059	27,117	58,783
Area 11	-	-	-	-	-	-	-	-	-	-	-	-
Total	5,000	21,500	1,100	500	1,500	2,300	11,500	12,200	23,800	40,400	30,300	64,100
Seawall Sector												
Area 1	5,295	22,769	10,707	1,505	12,212	18,318	5,247	-	5,247	8,920	22,754	50,006
Area 2	59	254	3,232	10,220	13,452	20,178	3,459	815	4,274	7,266	17,785	27,698
Area 3	-	-	-	-	-	-	-	-	-	-	-	-
Area 4	-	-	-	1,018	1,018	1,527	-	-	-	-	1,018	1,527
Area 5	9	39	838	-	838	1,257	1,113	-	1,113	1,892	1,960	3,188
Area 6	-	-	-	-	-	-	-	-	-	-	-	-
Total	5,400	23,100	14,800	12,700	27,500	41,300	9,800	800	10,600	18,100	43,500	82,400
Margaret's Creek Sector												
Area 9	711	3,100	12,285	5,225	17,500	26,300	-	-	-	-	18,200	29,400
Total All Sectors*	11,100	47,700	28,200	18,400	47,000	70,000	21,300	13,000	34,000	59,000	92,000	176,000

CY - Cubic Yards

* - Total volumes and weights for source materials are rounded to the nearest hundred and the total volumes and weights for soil and sediment are rounded to the nearest thousand

Table 5-2
Cleanup Levels for Chemicals of Concern for the Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

	Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Media: Soil and Sediment Site Area: Raritan Bay Slag Superfund Site Available Use: Residential and Recreational Controls to Ensure Restricted Use (if applicable): N/A	Lead	400 mg/kg	Both OSWER screening level for residential soil and ecological risk based value.	See Notes 1 and 2
Media: Surface Water Site Area: Raritan Bay Slag Superfund Site Available Use: Fishing Controls to Ensure Restricted Use (if applicable): N/A	Arsenic	36 µg/L	NJDEP SWQC	Based on Saline water criteria - chronic ³
	Copper	3.1 µg/L	NJDEP SWQC	Based on Saline water criteria - chronic ³
	Iron	1,000 µg/L	National Recommended Water Quality Criteria	Based on freshwater water criteria - chronic ⁴
	Lead	24 µg/L	NJDEP SWQC	Based on Saline water criteria - chronic ³
	Manganese	120 µg/L	EPA Region 3 BTAG screening benchmark	Based on freshwater value ⁵
	Vanadium	20 µg/L	EPA Region 3 BTAG screening benchmark	Based on freshwater value ⁵
	Zinc	81 µg/L	NJDEP SWQC	Based on Saline water criteria - chronic ³

Notes:

1. Developed from a CDC recommendation based on no more than 10% of the population should have a blood lead level greater than 10 ug/dl, as predicted from the IEUBK model.
2. Ecological risk based PRGs consist of the lowest concentration of lead which produced a lowest-observed-adverse-effect-level (LOAEL)- based hazard quotient of 1 in the most sensitive receptor evaluated in the food chain exposure models using site-specific sediment-to-food item bioaccumulation factors.
3. Chronic aquatic life protection criteria are determined with no exceedance at or above the minimum average seven consecutive day flow with a statistical recurrence interval of 10 years and expressed as four-day average.
4. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.
5. Based on a survey of published standard acute aquatic toxicity tests using juvenile or adult organisms. The test endpoints are the median lethal concentration (LC50) or median effective concentration (EC50) for death or some equivalent (e.g., immobilization).

µg/L - microgram per liter
 BTAG - Biological Technical Assistance Group
 mg/kg - milligrams per kilogram

NJDEP - New Jersey Department of Environmental Protection
 OSWER - Office of Solid Waste and Emergency Response
 SWQC - Surface Water Quality Criteria

Table 5-3
Summary of Volumes Addressed by Remedial Components
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

	Alternative 2				Alternative 3				Alternative 4				Alternative 5			
	Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment	
	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors
Volume addressed by Off-site Disposal (CY) *	5,000	6,100	25,300	55,700	-	-	25,300	55,700	-	-	10,400	-	-	-	19,600	-
Volume addressed by On-site Containment (CY) *	-	-	-	-	5,000	6,100	-	-	5,000	6,100	5,700	55,700	5,000	6,100	5,700	55,700
Volume addressed by Capping (CY) *	-	-	-	-	-	-	-	-	-	-	9,200	-	-	-	-	-
Total Volume (CY) *	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700

Notes:
 CY - Cubic Yards
 MC - Margaret's Creek
 Alternative 1 - No Action
 Alternative 2 – Excavation/Dredging, Offsite Disposal, and Monitoring
 Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring
 Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring
 Alternative 5 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring
 * - All volumes are rounded to the nearest hundred CY

Table 7-1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe: Current/Future Medium: Sitewide Surface/Subsurface Soil Exposure Medium: Sitewide Surface/Subsurface Soil								
Exposure Point	Chemical of Concern	Concentration Detected		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Sitewide Surface/Subsurface Soil - ingestion	Lead	1.1	47700 J	mg/kg	999/1046	208/234 ¹	mg/kg	Mean
Sitewide Surface/Subsurface Soil - ingestion	Lead - TRW	3.3	400	mg/kg	191/191	-	-	-

Scenario Timeframe: Future Medium: Area 2 Surface Soil								
Exposure Point	Chemical of Concern	Concentration Detected		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Area 2 Surface Soil	Lead	6.7	3000	mg/kg	94/94	485	mg/kg	Mean
Area 2 Surface Soil	Lead - TRW	25	8800	mg/kg	32/32	685	mg/kg	Mean

Key

mg/kg = milligram per kilogram

Mean - arithmetic mean concentration

Lead - TRW samples were collected in accordance with EPA Technical Review Workgroup (TRW) guidance (EPA 2000). TRW samples are composite samples collected from the near surface (0-2 inches below the ground surface) as soil from this depth is assumed to be most readily ingested by children. Lead - TRW samples were utilized only in the IEUBK model to evaluate exposure to children.

¹: 208 indicates the EPC for current exposures, 234 indicates the EPC for future exposures

Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

This table presents the primary chemical of concern (COC) and its exposure point concentration in soil (i.e., the concentration that will be used to estimate the exposure and risk from lead). The table includes the range of concentrations detected for lead, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the site), the EPC and how it was derived.

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Surface Soil	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting Area 1.
						Ingestion	Quant	
						Inhalation	Quant	
			Area 2	Trespassers	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Access to Area 2 is currently restricted by a fence. Public health hazard signs are posted warning no swimming, no sunbathing, and no fishing in the area. However, trespassers may gain access to the fenced area. While trespassing, trespassers may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 3 and 4	Recreational Users	Adult, Adolescent (6-18 yrs), and Child (0-6 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting playground and the surrounding area.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 3 and 4	Outdoor Worker	Adult	Dermal	Quant	Outdoor workers may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while working in the area.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting beach in these areas.
						Ingestion	Quant	
						Inhalation	Quant	

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Surface Soil	Areas 8 and 11	Trespassers	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Access to Areas 8 and 11 is currently restricted by a fence. However, trespassers may gain access to the fenced area. While trespassing, trespassers may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil.
						Ingestion	Quant	
						Inhalation	Quant	
			Upland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting Margaret's Creek.
						Ingestion	Quant	
						Inhalation	Quant	
			All Areas (except Areas 2, 8, and 11)	Pedestrian	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Pedestrians may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting the site.
	Ground-water	Ground-water	All Upland Areas	Construction/Utility Worker	Adult	Dermal	Quant	Construction/Utility workers may come into contact with contaminants in soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while working in the upland areas.
						Ingestion	Quant	
						Inhalation	Quant	
			All Areas	Resident	Adult and Child (0-6 yrs)	Dermal	None	Residents in the area are connected to the municipal water system. Groundwater is not used as a potable drinking water supply due to high salinity.
						Ingestion	None	
						Inhalation	None	
			All Upland Areas	Construction/Utility Worker	Adult	Dermal	Quant	Construction/utility workers may encounter shallow groundwater at upland areas of Areas 6, 8, and 9 where depth to groundwater is 10 feet or less. Routes of exposure include incidental ingestion of and dermal contact with groundwater.
						Ingestion	Quant	
						Inhalation	None	

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Surface Water	Surface Water	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with surface water while visiting Area 1. Routes of exposure include incidental ingestion of and dermal contact with surface water.
						Ingestion	Quant	
			Areas 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Dermal	Quant	Recreational visitors may come into contact with surface water while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with surface water.
						Ingestion	Quant	
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with surface water while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with surface water.
						Ingestion	Quant	
	Sediment	Sediment	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with sediment while visiting Area 1. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Ingestion	Quant	
			Areas 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Dermal	Quant	Recreational visitors may come into contact with sediment while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Ingestion	Quant	
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with sediment while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Ingestion	Quant	
	Biota	Biota	All Areas (except Areas 3 and 4)	Angler	Adult and Child (0-6 yrs)	Ingestion	Quant	People may consume self-caught fish and shellfish from the site. The angler scenario assesses exposure to adult anglers and young children (0 to 6 years old) who may consume fish and shellfish caught at the site by anglers.

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Surface Soil	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting Area 1.
						Ingestion	Quant	
						Inhalation	Quant	
			Area 2	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Area 2 may be open to the public in the future. Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 3 and 4	Recreational Users	Adult, Adolescent (6-18 yrs), and Child (0-6 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting playground and the surrounding area.
						Ingestion	Quant	
						Inhalation	Quant	
				Outdoor Worker	Adult	Dermal	Quant	Outdoor workers may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while working in the area.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting beach in these areas.
						Ingestion	Quant	
						Inhalation	Quant	
			Areas 8 and 11	Trespassers	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Trespassers may gain access to restricted areas. Trespassers may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil.
						Ingestion	Quant	
						Inhalation	Quant	

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Surface Soil	Upland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational users may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting Margaret's Creek.
						Ingestion	Quant	
						Inhalation	Quant	
			All Areas (except Areas 8 and 11)	Pedestrian	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Pedestrians may come into contact with contaminants in surface soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while visiting the site.
Future	Soil	Surface and Subsurface Soil	All Upland Areas	Construction/Utility Worker	Adult	Dermal	Quant	Construction/Utility workers may come into contact with contaminants in soil through incidental ingestion of and dermal contact with soil, and inhalation of particulates released from soil while working in the upland areas.
						Ingestion	Quant	
						Inhalation	Quant	
	Ground-water	Ground-water	All Areas	Resident	Adult and Child (0-6 yrs)	Dermal	Quant	Future development of the groundwater resource at the site is unlikely; however, in theory, potable water wells could be installed in the future. Future residents may come into contact with contaminants through ingestion of and dermal contact with groundwater, and inhalation of VOCs in groundwater while bathing or showering.
						Ingestion	Quant	
						Inhalation	Quant	
			All Upland Areas	Construction/Utility Worker	Adult	Dermal	Quant	Construction/utility workers may encounter shallow groundwater at upland areas of Areas 6, 8, and 9 where depth to groundwater is 10 feet or less. Routes of exposure include incidental ingestion of and dermal contact with groundwater.
						Ingestion	Quant	
						Inhalation	None	

Table 7-2
Selection of Exposure Pathways
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Water	Surface Water	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with surface water while visiting Area 1. Routes of exposure include incidental ingestion of and dermal contact with surface water.
			Areas 2, 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Ingestion	Quant	Recreational visitors may come into contact with surface water while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with surface water.
						Dermal	Quant	Recreational visitors may come into contact with surface water while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with surface water.
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Ingestion	Quant	Recreational visitors may come into contact with sediment while visiting Area 1. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Dermal	Quant	Recreational visitors may come into contact with sediment while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with sediment.
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Ingestion	Quant	Recreational visitors may come into contact with sediment while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with sediment.
	Sediment	Sediment	Area 1	Recreational Users	Adult and Adolescent (6-18 yrs)	Dermal	Quant	Recreational visitors may come into contact with sediment while visiting Area 1. Routes of exposure include incidental ingestion of and dermal contact with sediment.
			Areas 2, 5, 6, and Beach Area of Area 9	Recreational Users	Adult and Child (0-6 yrs)	Ingestion	Quant	Recreational visitors may come into contact with sediment while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Dermal	Quant	Recreational visitors may come into contact with sediment while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with sediment.
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Ingestion	Quant	Recreational visitors may come into contact with sediment while visiting beach in these areas. Routes of exposure include incidental ingestion of and dermal contact with sediment.
						Dermal	Quant	Recreational visitors may come into contact with sediment while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with sediment.
			Wetland Area of Area 9	Recreational Users	Adult and Adolescent (6-18 yrs)	Ingestion	Quant	Recreational visitors may come into contact with sediment while visiting wetlands in Area 9. Routes of exposure include incidental ingestion of and dermal contact with sediment.
	Biota	Biota	All Areas (except Areas 3 and 4)	Angler	Adult and Child (0-6 yrs)	Ingestion	Quant	People may consume self-caught fish and shellfish from the site. The angler scenario assesses exposure to adult anglers and young children (0 to 6 years old) who may consume fish and shellfish caught at the site by anglers.
					Adult and Adolescent (6-18 yrs)	Ingestion	Quant	People may consume self-caught fish and shellfish from the site. The angler scenario assesses exposure to adult anglers and young children (0 to 6 years old) who may consume fish and shellfish caught at the site by anglers.

Key

Quant = Quantitative risk analysis performed

None = Risk analysis not performed

Table 7-3
Non-Cancer Toxicity Data Summary
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Pathway: Ingestion/Dermal										
Chemicals of Concern	Chronic/Subchronic	Oral RfD Value	Oral RfD Units	Absorp. Efficiency (Dermal)	Adjusted RfD (Dermal)	Adj. Dermal RfD Units	Primary Target Organ	Combined Uncertainty /Modifying Factors	Sources of RfD Target Organ	Dates of RfD
Lead	Chronic	-	-	1	-	-	-	-	-	-

Pathway: Inhalation									
Chemicals of Concern	Chronic/Subchronic	Inhalation RfC	Inhalation RfC Units	Primary Target Organ	Inhalation RfD (If available)	Inhalation RfD Units (If available)	Combined Uncertainty /Modifying Factors	Sources of RfD Target Organ	Dates of RfC
Lead	Chronic	-	-	-	-	-	-	-	-

Key

- : no available data

Non-Cancer Toxicity Data Summary

Lead is not evaluated in the same manner as other contaminants. EPA has not published conventional quantitative toxicity values for lead because available data suggest a very low or possibly no threshold for adverse effects, even at exposure levels that might be considered background. However, the toxicokinetics of lead are well understood and indicate that lead is regulated based on the blood lead concentration. In lieu of evaluating risk using typical intake calculations and toxicity criteria, EPA developed models specifically to evaluate lead exposures. For this baseline human health risk assessment, blood lead concentrations were estimated using the Integrated Exposure Uptake Biokinetic model (IEUBK) and the Adult Lead Model (ALM). Lead only posed risk via the ingestion of soils exposure scenario.

Table 7-4
Cancer Toxicity Data Summary
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Pathway: Ingestion/ Dermal							
Chemical of Concern	Oral Cancer Slope Factor	Units	Adjusted Cancer Slope Factor (for Dermal)	Slope Factor Units	Weight of Evidence/ Cancer Guideline	Source	Date
Lead	-	-	-	-	B2	IRIS	1/2/2013

Pathway: Inhalation							
Chemical of Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Slope Factor Units	Weight of Evidence/ Cancer Guideline	Source	Date
Lead	-	-	-	-	-	-	-

Key

- : no available data

IRIS: Integrated Risk Information System

Weight of Evidence definitions:

- A: Human carcinogen
- B1: Probable human carcinogen - Indicates that limited human data are available
- B2: Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans
- C: Possible human carcinogen
- D: Not classifiable as a human carcinogen
- E: Evidence of noncarcinogenicity

Cancer Toxicity Data Summary

Lead, the sole risk driver at the Raritan Bay Slag site, is not evaluated for carcinogenic risk. There is no evidence of carcinogenic endpoints in humans.

Table 7-5
Risk Characterization Summary - Non-Carcinogens
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe: Current/Future Receptor Population: Developing Fetuses of Female Construction/Utility Workers Receptor Age: Adult								
Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Sitewide Surface & Subsurface Soil	Sitewide Surface & Subsurface Soil - ingestion	Lead	-	-	-	-	-

Scenario Timeframe: Future Receptor Population: Recreators Receptor Age: Child								
Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Area 2 Surface Soil	Area 2 Surface Soil - ingestion	Lead	-	-	-	-	-

Key

- : no available data

Risk Characterization Summary - Non-Carcinogens

Lead can affect almost every organ and system in the human body. In children, the main target for lead toxicity is the nervous system; for adult females, it is the development of fetuses. Protection of young children is considered achieved if the odds of a typical or hypothetical child with blood lead levels (BLLs) greater than 10 micrograms per deciliter or greater is no more than 5 percent. At the Raritan Bay Slag site, BLLs may reach 11% greater than 5 micrograms per deciliter for the developing fetuses of adult female construction/utility workers and 42% in child recreators.

Table 7-6
Risk Characterization Summary - Carcinogens
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Timeframe: Current/Future Receptor Population: Developing Fetuses of Female Construction/Utility Workers Receptor Age: Adult							
Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Sitewide Surface & Subsurface Soil	Sitewide Surface & Subsurface Soil - ingestion	Lead	-	-	-	-

Scenario Timeframe: Future Receptor Population: Recreators Receptor Age: Child							
Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Area 2 Surface Soil	Area 2 Surface Soil - ingestion	Lead	-	-	-	-

Key

- : no available data

Risk Characterization Summary - Non-Carcinogens

Lead, the sole risk driver at the Raritan Bay Slag site, is not evaluated for carcinogenic risk. There is no evidence of carcinogenic endpoints in humans.

Table 7-7
Integrated Exposure Uptake BioKinetic Lead Model
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Time Frame	Receptor Population	Exposure Area	Model Output Categories	Lead Concentration			Geomean Blood Lead Concentration (µg/dL)	Percentage of Children with Blood Lead Concentrations Above 10 µg/dL ¹
				Soil (mg/kg)	Groundwater (µg/L)	Tissue (mg/kg)		
Current	Recreational User	Areas 5, 6, and Beach Area of Area 9	Incidental Ingestion of Soil	68	--	--	1.6	0.004%
	Angler	All Areas (except Areas 3 and 4)	Ingestion of Hard Clam	--	--	1.696	3.8	1.85%
			Ingestion of Ribbed Mussel	--	--	0.361	3.1	0.58%
			Ingestion of Blue Crab Muscle	--	--	0.111	2.9	0.44%
			Ingestion of Blue Crab Muscle Plus Hepatopancreas	--	--	0.102	2.9	0.44%
Future	Recreational User	Area 2	Incidental Ingestion of Soil	485 (total lead)	--	--	5.4	9.68%
			Incidental Ingestion of Soil	685 (fine fraction, bioavailability 42%)	--	--	9.1	42.16%
		Areas 5, 6, and Beach Area of Area 9	Incidental Ingestion of Soil	67.96	--	--	1.6	0.004%
	Resident	All Areas	Ingestion of Groundwater as Drinking Water Source	--	10.57	--	3.4	1.007%
	Angler	All Areas (except Areas 3 and 4)	Ingestion of Hard Clam	--	--	1.696	3.8	1.85%
			Ingestion of Ribbed Mussel	--	--	0.36	3.1	0.58%
			Ingestion of Blue Crab Muscle	--	--	0.111	2.9	0.44%
			Ingestion of Blue Crab Muscle Plus Hepatopancreas	--	--	0.102	2.9	0.44%

Key

mg/kg = milligram per kilogram

µg/dL = microgram per deciliter

µg/L = micrograms per liter

-- = not applicable

¹ Target blood lead level of concern = 10 µg/dL

Bold indicates value exceeds the 5% probability threshold of concern

Table 7-8
Adult Lead Model
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Time Frame	Receptor Population	Exposure Area	Receptor	Model Output Categories	Lead		Estimated Adult/ Adolescent Blood Lead Concentrations	Estimated Fetal Blood Concentrations (µg/dL)	Probability of Fetal Blood Lead
					Soil (mg/kg)	Tissue (mg/kg)			
Current	Recreational User	Area 1	Adult	Incidental Ingestion of Soil	557	--	1.7	4.1	0.08%
			Adolescent	Incidental Ingestion of Soil	557	--	1.7	4.1	0.08%
		Area 5, Area 6, and Beach Area of Area 9	Adult	Incidental Ingestion of Soil	68	--	1.1	2.6	0.004%
		Upland Area of Area 9	Adult	Incidental Ingestion of Soil	251	--	1.3	3.1	0.02%
			Adolescent	Incidental Ingestion of Soil	251	--	1.3	3.1	0.02%
		Wetland Area of Area 9	Adult	Incidental Ingestion of Sediment	117	--	1.2	2.7	0.01%
			Adolescent	Incidental Ingestion of Sediment	117	--	1.0	2.4	0.002%
	Pedestrian	All Areas (except Areas 2, 8 and 11)	Adult	Incidental Ingestion of Soil	215	--	2.0	4.7	0.17%
			Adolescent	Incidental Ingestion of Soil	215	--	2.0	4.7	0.17%
	Construction/Utility Worker	All Upland Areas	Adult	Incidental Ingestion of Soil (Surface and Subsurface)	408	--	5.4	12.8	11.14%
	Angler	All Areas (except Areas 3 and 4)	Adult	Ingestion of Hard Clam	--	1.7	2.3	5.4	0.37%
				Ingestion of Ribbed Mussel	--	0.36	1.3	3.0	0.01%
				Ingestion of Blue Crab Muscle	--	0.11	1.1	2.6	0.004%
				Ingestion of Blue Crab Muscle Plus Hepatopancreas	--	0.11	1.1	2.6	0.004%

Table 7-8
Adult Lead Model
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Scenario Time Frame	Receptor Population	Exposure Area	Receptor	Model Output Categories	Lead		Estimated Adult/ Adolescent Blood Lead Concentrations	Estimated Fetal Blood Concentrations (µg/dL)	Probability of Fetal Blood Lead
					Soil (mg/kg)	Tissue (mg/kg)			
Future	Recreational User	Area 1	Adult	Incidental Ingestion of Soil	557	--	1.7	4.1	0.08%
			Adolescent	Incidental Ingestion of Soil	557	--	1.7	4.1	0.08%
		Area 2	Adult	Incidental Ingestion of Soil, total lead	485	--	1.6	3.9	0.06%
				Incidental Ingestion of Soil, fine fraction	685	--	2.3	5.4	0.35%
		Area 5, Area 6, and Beach Area of Area 9	Adult	Incidental Ingestion of Soil	68	--	1.1	2.6	0.004%
		Upland Area of Area 9	Adult	Incidental Ingestion of Soil	251	--	1.3	3.1	0.02%
			Adolescent	Incidental Ingestion of Soil	251	--	1.3	3.1	0.02%
		Wetland Area of Area 9	Adult	Incidental Ingestion of Sediment	117	--	1.2	2.7	0.01%
			Adolescent	Incidental Ingestion of Sediment	117	--	1.0	2.4	0.002%
	Pedestrian	All Areas (except Areas 8 and 11)	Adult	Incidental Ingestion of Soil	234	--	2.1	4.9	0.22%
			Adolescent	Incidental Ingestion of Soil	234	--	2.1	4.9	0.22%
	Construction/ Utility Worker	All Upland Areas	Adult	Incidental Ingestion of Soil (Surface and Subsurface)	408	--	5.4	12.8	11.14%
	Angler	All Areas (except Areas 3 and 4)	Adult	Ingestion of Hard Clam	--	1.7	2.3	5.4	0.37%
				Ingestion of Ribbed Mussel	--	0.36	1.3	3.0	0.01%
				Ingestion of Blue Crab Muscle	--	0.11	1.1	2.6	0.004%
				Ingestion of Blue Crab Muscle Plus Hepatopancreas	--	0.11	1.1	2.6	0.004%

Key

mg/kg = milligram per kilogram

µg/dL = microgram per deciliter

-- = not applicable

¹ Target blood lead level of concern = 10 µg/dL

Bold indicates value exceeds the 5% probability threshold of concern

Adult exposure to groundwater is covered under Integrated Exposure Uptake Biokinetic Model for Lead in Children

Table 7-9
Summary of Toxicity Data Used to Screen Chemicals of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

<p>Soil</p> <p>To evaluate soil quality at the site, soil concentrations were compared to ecological screening criteria for soil toxicity to terrestrial plants, terrestrial invertebrate, avian and mammalian receptors. These criteria are literature values that are based on laboratory studies. The literature values used in developing this Record of Decision (ROD) were based on the following:</p> <p>United States Environmental Protection Agency (EPA) Ecological Soil Screening Levels (EcoSSLs) (EPA 2003 to 2008) - These values represent concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems.</p> <p>Preliminary Remediation Goals (PRGs) for Ecological Endpoints (Efroymson et al. 1997) - These values consist of media and chemical specific upper concentration limits anticipated to be protective of ecological receptors. These values tend to correspond to minimal and acceptable levels of effects on individual organisms which would be expected to cause minimal effects on ecological populations and communities.</p> <p>EPA Region 5, Resource, Conservation, and Recovery Act (RCRA) Ecological Screening Levels (ESLs) (EPA 2003) - These values represent a compilation of protective benchmarks for various media-specific ecological receptors intended to function as screening levels.</p>
<p>Sediment</p> <p>To evaluate sediment quality at the site, sediment concentrations were compared to ecological screening criteria for sediment toxicity to benthic macroinvertebrates. These criteria are literature values that are based on studies of a wide variety of aquatic systems. The literature values used in developing this ROD were based on the following:</p> <p>Effects Range Low (ERL) (Long and Morgan 1990) – These values represent the lowest 10th percentile of concentrations at which toxic effects were observed. At concentrations below the ERL, toxic effects are rarely expected.</p> <p>Effects Range Median (ERM) (Long and Morgan 1990) – These values represent the 50th percentile (median) at which toxic effects were observed. At concentrations above the ERM, toxic effects are likely to occur.</p> <p>EPA Region 3 Biological Technical Assistance Group (BTAG) Marine Sediment Screening Benchmarks (EPA 2006) - These values represent concentrations protective of marine receptors. Values for iron and endosulfan II consist of freshwater sediment ESLs as directed by the reference document when no marine values were available.</p>
<p>Surface Water</p> <p>To evaluate surface water quality at the site, surface water concentrations were compared ecological screening criteria for surface water toxicity to aquatic receptors. These criteria are literature values that are based on laboratory studies. The literature values used in developing this ROD were based on the following:</p> <p>New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards, Saline Water Chronic Values (NJDEP 2009) - These water quality criteria are developed for individual pollutants to protect aquatic life (survival, growth and reproduction of plants and animals) that live in saline waters.</p> <p>EPA Region 3 BTAG Marine Screening Benchmarks (EPA 2006) - These values represent concentrations protective of aquatic freshwater receptors (fish and invertebrate). Values for iron, manganese and vanadium consist of freshwater ESLs as directed by the reference document as no marine values were available.</p> <p>EPA National Recommended Water Quality Criteria (EPA 2002) – These values consist of a compilation of recommended water quality criteria for the protection of aquatic life in surface water, and provide guidance for states and tribes to use in adopting water quality standards.</p>

Table 7-9
Summary of Toxicity Data Used to Screen Chemicals of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Food Chain Model Evaluations

Toxicity Reference Values (TRVs) are species-specific and chemical-specific estimates of an exposure level that is not likely to cause unacceptable adverse effects on growth, reproduction, or survival. When evaluating risks to wildlife via ingestion pathways, dose-based (expressed in units of mg/kg-day) are typically used. The literature values used in developing this ROD were based on the following:

Toxicological Benchmarks for Wildlife: 1996 Revision - These benchmarks consider contaminant exposure through oral ingestion of contaminated media and consist of no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL) -based benchmarks. The NOAEL-based benchmarks represent values believed to be nonhazardous for the listed wildlife species; LOAEL -based benchmarks represent threshold levels at which adverse effects are likely to become evident. The benchmark for lead is based upon a reproduction endpoint. (Sample et. al 1996).

References:

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Table 7-10
Occurrence, Distribution, and Selection of Chemicals of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Exposure Media (concentration unit)	Chemical of Potential Concern	Minimum Concentra tion	Maximum Concentra tion	95% UCL of the Mean ¹	Background Concentration ²	Ecological Screening Value	Ecological Screening Value Source	Hazard Quotient ³	Chemical of Concern?
Area 1 Sediment (mg/kg)	Lead	12	5,860	1,098	181.5	218	NJDEP ER-M	5.0	Yes
Area 9 Soil (mg/kg)	Lead	1.7 J	10,200 J	612.5	5.7	11	Eco-SSL	56	Yes
Area 1 Surface Water (µg/L)	Copper (dissolved)	3.1 J	82.6 J	NC	ND	3.1	NRWCQ	26.6	Yes
	Lead (dissolved)	11.9 J	1,780 J	NC	ND	8.1	NRWCQ	220	Yes
	Arsenic (total)	2.7 J	70.9	44.2	ND	36	NJDEP CV	1.2	Yes
	Copper (total)	32.4 J	154 J	154 *	ND	3.1	NJDEP CV	50	Yes
	Iron (total)	345 J	6,320 J	2,278	ND	300	EPA R3	7.6	Yes
	Lead (total)	6.7 J	1,580 J	675	ND	24	NJDEP CV	28	Yes
	Manganese (total)	60.3 J	309 J	206.8	73.7	120	EPA R3	1.7	Yes
	Vanadium (total)	65.2 J	65.2 J	65.2 *	ND	20	EPA R3	3.3	Yes
Area 8 Surface Water (µg/L)	Zinc (total)	67.4 J	255 J	255 *	ND	81	NJDEP CV	3.1	Yes
	Arsenic (dissolved)	2.5 J	79.7	49.8	ND	36	NJDEP CV	1.4	Yes
	Copper (dissolved)	45.2 J	197 J	197 *	ND	3.1	NJDEP CV	64	Yes
	Iron (dissolved)	348 J	7,900 J	2,763	ND	300	EPA R3	9.2	Yes
	Lead (dissolved)	5.1 J	1,810 J	1,810 *	ND	24	NJDEP CV	75	Yes
	Manganese (dissolved)	77.7 J	330 J	215.9	ND	120	EPA R3	1.8	Yes
	Vanadium (dissolved)	63.8 J	63.8 J	63.8 *	ND	20	EPA R3	3.2	Yes
	Zinc (dissolved)	81.6 J	363 J	363 *	ND	81	NJDEP CV	4.5	Yes

Notes

1 - value consists of the 95% Upper Confidence Level (UCL) of mean concentrations of chemicals detected in each exposure media

2 - background concentrations consist of the 95% Upper Prediction Limit (UPL) for each exposure media

3 - hazard quotient is defined as the 95% UCL of a chemical divided by it's ecological screening value

mg/kg - milligrams per kilogram

µg/L - micrograms per liter

J - estimated value

NC - not calculated

ND - chemical not detected in background samples

Eco-SSL - United States Environmental Protection Agency (EPA) Ecological Soil Screening Levels (EcoSSLs) for Lead. March 2005

EPA R3 - EPA Region 3 Biological Technical Assistance Group Marine Screening Benchmarks (freshwater values as directed), July 2006

NJDEP ER-M - New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program. 2009. Marine/Estuarine Sediment Screening Guidelines. Effects Range-Medium (ER-M) v.

NJDEP CV - NJDEP Surface Water Quality Standards, Saline Water Chronic Values (dissolved criteria), January 2011

NRWQC - EPA National Recommended Water Quality Criteria. Chronic Values for Saltwater, November 2002

* - 95% UCL unable to be calculated due to less than the required number of detections needed to calculate; maximum detected concentration used

Table 7-11
Ecological Exposure Pathways of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Exposure Medium	Sensitive Environment Present?	Receptor	Threatened/Endangered Species	Exposure Routes	Assessment Endpoints ²	Measurement Endpoints
Soil	No	Soil Invertebrates	No	Ingestion and direct contact with chemicals in soil	Survival, growth, and reproduction of terrestrial organisms (including plants and invertebrates) utilizing Area 9	Evaluate the toxicity of chemicals through a comparison of soil exposure point concentrations to ecological screening levels
		Plants		Uptake of chemicals in soil	Survival, growth, and reproduction of terrestrial organisms (including plants and invertebrates) utilizing Area 9	Evaluate the toxicity of chemicals through a comparison of soil exposure point concentrations to ecological screening levels
		Insectivorous birds	No	Incidental ingestion of chemicals in soil and ingestion of contaminated soil invertebrates	Survival, growth, and reproduction of insectivorous birds utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the American robin (<i>Turdus migratorius</i>)
		Insectivorous mammals	No	Incidental ingestion of chemicals in soil and ingestion of contaminated soil invertebrates	Survival, growth, and reproduction of insectivorous mammals utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the short-tailed shrew (<i>Blarina brevicauda</i>)
		Carnivorous birds	No	Incidental ingestion of chemicals in soil and ingestion of contaminated small mammals	Survival, growth, and reproduction of carnivorous birds utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the American kestrel (<i>Falco sparverius</i>)
		Carnivorous mammals	No	Incidental ingestion of chemicals in soil and ingestion of contaminated small mammals	Survival, growth, and reproduction of carnivorous mammals utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the red fox (<i>Vulpes vulpes</i>)
		Terrestrial herbivorous birds	No	Incidental ingestion of chemicals in soil and ingestion of contaminated plants	Survival, growth, and reproduction of terrestrial herbivorous birds utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the northern bobwhite (<i>Colinus virginianus</i>)
		Terrestrial herbivorous mammals	No	Incidental ingestion of chemicals in soil and ingestion of contaminated plants	Survival, growth, and reproduction of terrestrial herbivorous mammals utilizing Area 9	Evaluate daily dietary exposure to chemicals in soil via food chain exposure model using the eastern cottontail (<i>Sylvilagus floridanus</i>)

Table 7-11
Ecological Exposure Pathways of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Exposure Medium	Sensitive Environment Present?	Receptor	Threatened/Endangered Species	Exposure Routes	Assessment Endpoints ²	Measurement Endpoints
Sediment	No	Sediment Invertebrates	No	Ingestion and direct contact with chemicals in sediment	Survival, growth, and reproduction of aquatic organisms (including fish and invertebrates) utilizing Areas 1, 8, and 9	Evaluate the toxicity of chemicals through a comparison of sediment exposure concentrations to ecological screening levels
		Fish	No	Ingestion and direct contact with chemicals in sediment	Survival, growth, and reproduction of aquatic organisms (including fish and invertebrates) utilizing Areas 1, 8, and 9	Evaluate the toxicity of chemicals through a comparison of sediment exposure point concentrations to ecological screening levels
		Piscivorous birds	Yes ¹	Incidental ingestion of chemicals in sediment and ingestion of contaminated fish	Survival, growth, and reproduction of piscivorous birds utilizing Area 9	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the belted kingfisher (<i>Ceryle alcyon</i>)
					Survival, growth, and reproduction of piscivorous birds utilizing Area 1	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the osprey (<i>Pandion haliaetus</i>)
		Piscivorous mammals	No	Incidental ingestion of chemicals in sediment and ingestion of contaminated fish	Survival, growth, and reproduction of piscivorous mammals utilizing Area 9	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the mink (<i>Mustela vison</i>)
		Aquatic herbivorous mammals	No	Incidental ingestion of chemicals in sediment and ingestion of contaminated plants	Survival, growth, and reproduction of aquatic herbivorous mammals utilizing Area 9	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the muskrat (<i>Ondatra zibethicus</i>)
		Aquatic herbivorous birds	No	Incidental ingestion of chemicals in sediment and ingestion of contaminated plants	Survival, growth, and reproduction of aquatic herbivorous birds utilizing Area 1	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the Canada goose (<i>Branta canadensis</i>)
		Aquatic invertivorous birds	No	Incidental ingestion of chemicals in sediment and ingestion of contaminated sediment invertebrates	Survival, growth, and reproduction of invertivorous birds utilizing Area 1	Evaluate daily dietary exposure to chemicals in sediment via food chain exposure model using the semipalmated plover (<i>Charadrius semipalmatus</i>)

Table 7-11
Ecological Exposure Pathways of Concern
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Exposure Medium	Sensitive Environment Present?	Receptor	Threatened/ Endangered Species	Exposure Routes	Assessment Endpoints ²	Measurement Endpoints
Surface Water	No	Sediment Invertebrates	No	Ingestion and direct contact with chemicals in surface water	Survival, growth, and reproduction of aquatic organisms (including fish and invertebrates) utilizing Areas 1, 8, and 9	Evaluate the toxicity of chemicals through a comparison of surface water exposure point concentrations to ecological screening levels
		Fish	No	Ingestion and direct contact with chemicals in surface water	Survival, growth, and reproduction of aquatic organisms (including fish and invertebrates) utilizing Areas 1, 8, and 9	Evaluate the toxicity of chemicals through a comparison of surface water exposure point concentrations to ecological screening levels

Notes:

1 - The New Jersey Department of Environmental Protection reported the presence of black-crowned night heron (*Nycticorax nycticorax*) and osprey (*Pandion haliaetus*) within or 1/4 miles of the site, respectively. Osprey were observed on site during remedial investigation field activities.

2 - Area 1 served as a surrogate in evaluating risks from contaminants in Area 8 sediment

Table 7-12
Chemical Concentrations Expected to Provide Adequate Protection of Ecological Receptors
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Habitat	Exposure Medium	Chemical	Protective Concentration	Basis	Assessment Endpoint
Upland disturbed forest, scrub/shrub, tidal marsh, and intertidal/subtidal zones of Raritan Bay	Soil/ Sediment	Lead	400 mg/kg	Unified value based in part on food chain exposure modeling and developed due to concerns that separate medium-specific values for soil and sediment would not be protective to site environments as daily tidal flushing and commingling of soils and sediments would result in cross contamination if separate values were implemented	Survival, growth, and reproduction of invertivorous birds utilizing Area 1
Open water	Surface Water	Arsenic	36 µg/L	NJDEP value selected as it is an applicable requirement	Survival, growth, and reproduction of aquatic organisms (including fish and invertebrates) utilizing Areas 1, 8, and 9
		Copper	3.1 µg/L	NJDEP value selected as it is an applicable requirement	
		Iron	1,000 µg/L	No NJDEP marine value available; NRWQC freshwater ESL selected as directed	
		Lead	24 µg/L	NJDEP value selected as it is an applicable requirement	
		Manganese	120 µg/L	No NJDEP marine value available; EPA R3 freshwater ESL selected as directed	
		Nickel	22 µg/L	NJDEP value selected as it is an applicable requirement	
		Vanadium	20 µg/L	No NJDEP marine value available; EPA R3 freshwater ESL selected as directed	
		Zinc	81 µg/L	NJDEP value selected as it is an applicable requirement	

Notes:

mg/kg - milligrams per kilogram

µg/L - micrograms per liter

NJDEP - New Jersey Department of Environmental Protection Surface Water Quality Standards, Saline Water Chronic Values (dissolved criteria), January 2011

NRWQC - United States Environmental Protection Agency (EPA) National Recommended Water Quality Criteria. Chronic Values for Freshwater, 2009

EPA R3 - EPA Region 3 Biological Technical Assistance Group Marine Screening Benchmarks (freshwater values as directed), July 2006

ESL - ecological screening level

Table 10-1
Summary of Capital, O & M and Present Worth Costs
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

COST TYPE	Alternative 1 - No Action	Alternative 2 - Excavation/Dredging, Offsite Disposal And Monitoring	Alternative 3 - Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring	Alternative 4 — Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring	Alternative 5 — Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring
CAPITAL COSTS	\$0	\$78.2 Million	\$69.0 Million	\$44.2 Million	\$47.9 Million
PRESENT WORTH OPERATION AND MAINTENANCE (O & M) AND PERIODIC COSTS	\$0	\$0.5 Million	\$4.0 Million	\$5.6 Million	\$4.5 Million
TOTAL PRESENT WORTH COSTS (CAPITAL AND O & M)	\$0	\$78.7 Million	\$73.0 Million	\$49.8 Million	\$52.4 Million

Notes:

Costs presented have an expected accuracy range for feasibility study estimates (-30% to +50% of the actual cost of the alternative).
Costs are rounded to the nearest \$100,000

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring			COST ESTIMATE SUMMARY		
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.			
Location:	Middlesex County, New Jersey				
Phase:	Feasibility Study				
Base Year:	2012				
Date:	September 2012				
CAPITAL COSTS: (Assumed to be Incurred During Year 0)					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
General Conditions	1	LS	\$640,088	\$640,088	See MII Project Cost Summary Report Page 3
Mobilization	1	LS	\$150,000	\$150,000	See MII Project Cost Summary Report Page 1
Sediment and Erosion Control Measures	1	LS	\$1,997,689	\$1,997,689	See MII Project Cost Summary Report Page 4
Construction and Removal of Access Roads					
Access Road to Bay	1	LS	\$417,825	\$417,825	See MII Project Cost Summary Report Page 1
Access Road to Margaret Creek	1	LS	\$122,578	\$122,578	See MII Project Cost Summary Report Page 2
Removal and Handling of Contaminated Materials by Area					
Seawall Sector Site Activities	1	LS	\$2,710,396	\$2,710,396	See MII Project Cost Summary Report Page 5
Jetty Sector Site Activities	1	LS	\$4,597,453	\$4,597,453	See MII Project Cost Summary Report Page 6
Margaret's Creek Sector Site Activities	1	LS	\$354,516	\$354,516	See MII Project Cost Summary Report Page 6
Post Excavation Confirmation Sampling	1	LS	\$232,286	\$232,286	See MII Project Cost Summary Report Page 6
Transportation and Offsite Disposal of Excavated Materials					
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Seawall Areas	1	LS	\$4,677,357	\$4,677,357	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Western Jetty Areas	1	LS	\$4,355,495	\$4,355,495	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Margaret's Creek Area	1	LS	\$620,194	\$620,194	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Seawall Areas	1	LS	\$11,778,263	\$11,778,263	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Western Jetty Areas	1	LS	\$7,568,057	\$7,568,057	See MII Project Cost Summary Report Page 8
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Margaret's Creek Area	1	LS	\$5,348,635	\$5,348,635	See MII Project Cost Summary Report Page 8
Site Restoration					
Seawall Reconstruction	1	LS	\$2,796,853	\$2,796,853	See MII Project Cost Summary Report Page 9
Jetty Reconstruction	1	LS	\$911,493	\$911,493	See MII Project Cost Summary Report Page 9
Backfill of Excavations	1	LS	\$5,282,669	\$5,282,669	See MII Project Cost Summary Report Page 9

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring				COST ESTIMATE SUMMARY		
Site:	Raritan Bay	Description:	The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.			
Location:	Middlesex County, New Jersey					
Phase:	Feasibility Study					
Base Year:	2012					
Date:	September 2012					
Wetland Restoration (for Bay Areas only)	1	LS	\$914,093	\$914,093	See MII Project Cost Summary Report Page 10	
Demobilization and Decontamination	1	LS	\$250,000	\$250,000	See MII Project Cost Summary Report Page 1	
			SUBTOTAL	\$55,725,940		
Contingency (Scope and Bid)	20%			\$11,145,188	10% Scope, 10% Bid (Low end of the recommended range).	
			SUBTOTAL	\$66,871,128		
Project Management	5%			\$3,343,556	Recommended range from EPA 540-R-00-002 was used.	
Remedial Design	6%			\$4,012,268	Recommended range from EPA 540-R-00-002 was used.	
Construction Management	6%			\$4,012,268	Recommended range from EPA 540-R-00-002 was used.	
			TOTAL	\$78,239,220		
			TOTAL CAPITAL COST	\$78,239,000	Total capital cost is rounded to the nearest \$1,000.	
MONITORING COSTS: (Assumed to be Incurred During Year 1 through 2)						
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES	
Quaterly Monitoring of Surface Water	1	EA	\$41,786	\$41,786	See MII Project Cost Summary Report Page 2	
			SUBTOTAL	\$41,786		
Contingency (Scope and Bid)	20%			\$8,357	10% Scope, 10% Bid (Low end of the recommended range).	
			SUBTOTAL	\$50,143		
Project Management	10%			\$5,014	Recommended range from EPA 540-R-00-002 was used.	
Technical Support	15%			\$7,521	Middle value of the recommended range was used.	
			TOTAL	\$62,678		
			TOTAL QUARTERLY MONITORING COSTS	\$63,000	Total quarterly monitoring cost is rounded to the nearest \$1,000.	

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring			COST ESTIMATE SUMMARY		
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.			
Location:	Middlesex County, New Jersey				
Phase:	Feasibility Study				
Base Year:	2012				
Date:	September 2012				
MONITORING COSTS: (Assumed to be Incurred During Year 3 through 5)					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Semi-Annual Monitoring of Surface Water	1	EA	\$22,703	\$22,703	See MII Project Cost Summary Report Page 2
			SUBTOTAL	\$22,703	
Contingency (Scope and Bid)	20%			\$4,541	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	\$27,244	
Project Management	10%			\$2,724	Recommended range from EPA 540-R-00-002 was used. Middle value of the recommended range was used.
Technical Support	15%			\$4,087	
			TOTAL	\$34,055	
TOTAL SEMI-ANNUAL MONITORING COSTS				\$34,000	Total quarterly monitoring cost is rounded to the nearest \$1,000.
FIVE-YEAR POLICY REVIEW PERIODIC COSTS					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	LS	\$42,035	\$42,035	See MII Project Cost Summary Report Page 1
			SUBTOTAL	\$42,035	
Contingency (Scope and Bid)	20%			\$8,407	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	\$50,442	
Project Management	10%			\$5,044	The high end of the recommended range was used.
			TOTAL	\$55,486	
TOTAL FIVE-YEAR POLICY REVIEW PERIODIC COST				\$55,000	Periodic cost is rounded to the nearest \$1,000.

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring		COST ESTIMATE SUMMARY
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.
Location:	Middlesex County, New Jersey	
Phase:	Feasibility Study	
Base Year:	2012	
Date:	September 2012	
Notes:		
1. A five year site review would not be conducted, but a policy review may be conducted within five years of construction completion for the site.		
2. Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.		
3. Supporting information, including MCACES MII Report, quantity take offs and vendor quotes are presented in Appendix D.		
Abbreviations:		
	EA	Each
	QTY	Quantity
	LS	Lump sum

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring						PRESENT VALUE ANALYSIS			
Site:	Raritan Bay					Escalation Rate:	3.16%		
Location:	Middlesex County, New Jersey					Discount Rate:	5.00%		
Phase:	Feasibility Study								
Base Year:	2012								
Date:	September 2012								
Year ¹	Capital Costs ²	ANNUAL COSTS		PERIODIC COSTS	Total Annual Expenditure ³	Escalation Factor	Escalated Cost ⁴	Discount Factor	Present Value ^{5,6}
		O&M Costs	Monitoring Costs	Five-Year Review					
0	\$78,239,000	\$0	\$0	\$0	\$78,239,000	1.0000	\$78,239,000	1.0000	\$78,239,000
1	\$0	\$0	\$63,000	\$0	\$63,000	1.0316	\$64,991	0.9524	\$61,897
2	\$0	\$0	\$63,000	\$0	\$63,000	1.0642	\$67,045	0.9070	\$60,809
3	\$0	\$0	\$34,000	\$0	\$34,000	1.0978	\$37,325	0.8638	\$32,242
4	\$0	\$0	\$34,000	\$0	\$34,000	1.1325	\$38,505	0.8227	\$31,678
5	\$0	\$0	\$34,000	\$55,000	\$89,000	1.1683	\$103,979	0.7835	\$81,467
6	\$0	\$0	\$0	\$0	\$0	1.2052	\$0	0.7462	\$0
7	\$0	\$0	\$0	\$0	\$0	1.2433	\$0	0.7107	\$0
8	\$0	\$0	\$0	\$0	\$0	1.2826	\$0	0.6768	\$0
9	\$0	\$0	\$0	\$0	\$0	1.3231	\$0	0.6446	\$0
10	\$0	\$0	\$0	\$55,000	\$55,000	1.3649	\$75,070	0.6139	\$46,085
11	\$0	\$0	\$0	\$0	\$0	1.4081	\$0	0.5847	\$0
12	\$0	\$0	\$0	\$0	\$0	1.4526	\$0	0.5568	\$0
13	\$0	\$0	\$0	\$0	\$0	1.4985	\$0	0.5303	\$0
14	\$0	\$0	\$0	\$0	\$0	1.5458	\$0	0.5051	\$0
15	\$0	\$0	\$0	\$55,000	\$55,000	1.5947	\$87,709	0.4810	\$42,188
16	\$0	\$0	\$0	\$0	\$0	1.6451	\$0	0.4581	\$0
17	\$0	\$0	\$0	\$0	\$0	1.6970	\$0	0.4363	\$0
18	\$0	\$0	\$0	\$0	\$0	1.7507	\$0	0.4155	\$0
19	\$0	\$0	\$0	\$0	\$0	1.8060	\$0	0.3957	\$0
20	\$0	\$0	\$0	\$55,000	\$55,000	1.8631	\$102,471	0.3769	\$38,621
21	\$0	\$0	\$0	\$0	\$0	1.9219	\$0	0.3589	\$0
22	\$0	\$0	\$0	\$0	\$0	1.9827	\$0	0.3418	\$0
23	\$0	\$0	\$0	\$0	\$0	2.0453	\$0	0.3256	\$0
24	\$0	\$0	\$0	\$0	\$0	2.1099	\$0	0.3101	\$0

Table 12-1
Summary of Cost Estimates – Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring						PRESENT VALUE ANALYSIS			
Site:	Raritan Bay					Escalation Rate:	3.16%		
Location:	Middlesex County, New Jersey					Discount Rate:	5.00%		
Phase:	Feasibility Study								
Base Year:	2012								
Date:	September 2012								
Year ¹	Capital Costs ²	ANNUAL COSTS		PERIODIC COSTS	Total Annual Expenditure ³	Escalation Factor	Escalated Cost ⁴	Discount Factor	Present Value ^{5,6}
		O&M Costs	Monitoring Costs	Five-Year Review					
25	\$0	\$0	\$0	\$55,000	\$55,000	2.1766	\$119,713	0.2953	\$35,351
26	\$0	\$0	\$0	\$0	\$0	2.2454	\$0	0.2812	\$0
27	\$0	\$0	\$0	\$0	\$0	2.3164	\$0	0.2678	\$0
28	\$0	\$0	\$0	\$0	\$0	2.3896	\$0	0.2551	\$0
29	\$0	\$0	\$0	\$0	\$0	2.4651	\$0	0.2429	
30	\$0	\$0	\$0	\$55,000	\$55,000	2.5430	\$139,865	0.2314	\$32,365
TOTALS:	\$78,239,000	\$0	\$228,000	\$330,000	\$78,797,000		\$79,075,671		\$78,701,703
TOTAL PRESENT VALUE OF Selected Remedy									\$78,702,000
Notes:									
1 - Duration is assumed to be 30 years for present value analysis. Estimated remedial timeframes are discussed within the FS report.									
2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on CS-2									
3 - Total annual expenditure is the total cost per year with no escalation or discounting.									
4 - Escalation cost is the total cost per year including an escalation rate for that year. See Table PV-AERFT for details.									
5 - Present value is the total cost per year including a discount factor for that year. See Table PV-ADRFT for details.									
6 - Total present value is rounded to the nearest \$1,000. Depreciation is excluded from the present value cost.									

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring		COST ESTIMATE SUMMARY			
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.			
Location:	Middlesex County, New Jersey				
Phase:	Feasibility Study				
Base Year:	2012				
Date:	September 2012				
CAPITAL COSTS: (Assumed to be Incurred During Year 0)					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
General Conditions	1	LS	\$640,088	\$640,088	See MII Project Cost Summary Report Page 3
Mobilization	1	LS	\$150,000	\$150,000	See MII Project Cost Summary Report Page 1
Sediment and Erosion Control Measures	1	LS	\$1,997,689	\$1,997,689	See MII Project Cost Summary Report Page 4
Construction and Removal of Access Roads					
Access Road to Bay	1	LS	\$417,825	\$417,825	See MII Project Cost Summary Report Page 1
Access Road to Margaret Creek	1	LS	\$122,578	\$122,578	See MII Project Cost Summary Report Page 2
Removal and Handling of Contaminated Materials by Area					
Seawall Sector Site Activities	1	LS	\$2,710,396	\$2,710,396	See MII Project Cost Summary Report Page 5
Jetty Sector Site Activities	1	LS	\$4,597,453	\$4,597,453	See MII Project Cost Summary Report Page 6
Margaret's Creek Sector Site Activities	1	LS	\$354,516	\$354,516	See MII Project Cost Summary Report Page 6
Post Excavation Confirmation Sampling	1	LS	\$232,286	\$232,286	See MII Project Cost Summary Report Page 6
Transportation and Offsite Disposal of Excavated Materials					
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Seawall Areas	1	LS	\$4,677,357	\$4,677,357	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Western Jetty Areas	1	LS	\$4,355,495	\$4,355,495	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Hazardous Slag and Battery Casings Removed from Margaret's Creek Area	1	LS	\$620,194	\$620,194	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Seawall Areas	1	LS	\$11,778,263	\$11,778,263	See MII Project Cost Summary Report Page 7
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Western Jetty Areas	1	LS	\$7,568,057	\$7,568,057	See MII Project Cost Summary Report Page 8
Transportation and Offsite Disposal of Soil and Dewatered Sediment Removed from Margaret's Creek Area	1	LS	\$5,348,635	\$5,348,635	See MII Project Cost Summary Report Page 8
Site Restoration					
Seawall Reconstruction	1	LS	\$2,796,853	\$2,796,853	See MII Project Cost Summary Report Page 9
Jetty Reconstruction	1	LS	\$911,493	\$911,493	See MII Project Cost Summary Report Page 9

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring				COST ESTIMATE SUMMARY		
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.				
Location:	Middlesex County, New Jersey					
Phase:	Feasibility Study					
Base Year:	2012					
Date:	September 2012					
Backfill of Excavations	1	LS	\$5,282,669	\$5,282,669	See MII Project Cost Summary Report Page 9	
Wetland Restoration (for Bay Areas only)	1	LS	\$914,093	\$914,093	See MII Project Cost Summary Report Page 10	
Demobilization and Decontamination	1	LS	\$250,000	\$250,000	See MII Project Cost Summary Report Page 1	
			SUBTOTAL	\$55,725,940		
Contingency (Scope and Bid)	20%			\$11,145,188	10% Scope, 10% Bid (Low end of the recommended range).	
			SUBTOTAL	\$66,871,128		
Project Management	5%			\$3,343,556	Recommended range from EPA 540-R-00-002 was used.	
Remedial Design	6%			\$4,012,268	Recommended range from EPA 540-R-00-002 was used.	
Construction Management	6%			\$4,012,268	Recommended range from EPA 540-R-00-002 was used.	
			TOTAL	\$78,239,220		
			TOTAL CAPITAL COST	\$78,239,000	Total capital cost is rounded to the nearest \$1,000.	
MONITORING COSTS: (Assumed to be Incurred During Year 1 through 2)						
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES	
Quarterly Monitoring of Surface Water	1	EA	\$41,786	\$41,786	See MII Project Cost Summary Report Page 2	
			SUBTOTAL	\$41,786		
Contingency (Scope and Bid)	20%			\$8,357	10% Scope, 10% Bid (Low end of the recommended range).	
			SUBTOTAL	\$50,143		
Project Management	10%			\$5,014	Recommended range from EPA 540-R-00-002 was used.	
Technical Support	15%			\$7,521	Middle value of the recommended range was used.	
			TOTAL	\$62,678		
			TOTAL QUARTERLY MONITORING COSTS	\$63,000	Total quarterly monitoring cost is rounded to the nearest \$1,000.	

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring			COST ESTIMATE SUMMARY		
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.			
Location:	Middlesex County, New Jersey				
Phase:	Feasibility Study				
Base Year:	2012				
Date:	September 2012				
MONITORING COSTS: (Assumed to be Incurred During Year 3 through 5)					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Semi-Annual Monitoring of Surface Water	1	EA	\$22,703	\$22,703	See MII Project Cost Summary Report Page 2
			SUBTOTAL	\$22,703	
Contingency (Scope and Bid)	20%			\$4,541	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	\$27,244	
Project Management	10%			\$2,724	Recommended range from EPA 540-R-00-002 was used. Middle value of the recommended range was used.
Technical Support	15%			\$4,087	
			TOTAL	\$34,055	
TOTAL SEMI-ANNUAL MONITORING COSTS				\$34,000	Total quarterly monitoring cost is rounded to the nearest \$1,000.
FIVE-YEAR POLICY REVIEW PERIODIC COSTS					
DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Five-Year Site Review	1	LS	\$42,035	\$42,035	See MII Project Cost Summary Report Page 1
			SUBTOTAL	\$42,035	
Contingency (Scope and Bid)	20%			\$8,407	10% Scope, 10% Bid (Low end of the recommended range).
			SUBTOTAL	\$50,442	
Project Management	10%			\$5,044	The high end of the recommended range was used.
			TOTAL	\$55,486	
TOTAL FIVE-YEAR POLICY REVIEW PERIODIC COST				\$55,000	Periodic cost is rounded to the nearest \$1,000.

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring		COST ESTIMATE SUMMARY
Site:	Raritan Bay	Description: The Selected Remedy includes common components (mobilization, demobilization and decontamination, construction of access roads, and monitoring of surface water) and alternative specific site activities, including removal of slag and battery casings; excavation of contaminated surface and subsurface soil; dredging of contaminated sediments; dewatering of sediment and applicable subsurface soils; post excavation confirmation sampling; disposal of contaminated materials; and site restoration (seawall and jetty reconstruction and backfilling excavations). All removed contaminated materials will be disposed of off site.
Location:	Middlesex County, New Jersey	
Phase:	Feasibility Study	
Base Year:	2012	
Date:	September 2012	
Notes:		
1. A five year site review would not be conducted, but a policy review may be conducted within five years of construction completion for the site.		
2. Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.		
3. Supporting information, including MCACES MII Report, quantity take offs and vendor quotes are presented in Appendix D.		
Abbreviations:		
	EA Each	
	QTY Quantity	
	LS Lump sum	

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring					PRESENT VALUE ANALYSIS				
Site: Raritan Bay Location: Middlesex County, New Jersey Phase: Feasibility Study Base Year: 2012 Date: September 2012					Discount Rate: 7.00%				
Year ¹	Capital Costs ²	ANNUAL COSTS		PERIODIC COSTS	Total Annual Expenditure ³	Escalation Factor	Escalated Cost ⁴	Discount Factor	Present Value ^{4,5}
		O&M Costs	Monitoring Costs	Five-Year Review					
0	\$78,239,000	\$0	\$0	\$0	\$78,239,000	1.0000	\$78,239,000	1.0000	\$78,239,000
1	\$0	\$0	\$63,000	\$0	\$63,000	1.0000	\$63,000	0.9346	\$58,880
2	\$0	\$0	\$63,000	\$0	\$63,000	1.0000	\$63,000	0.8734	\$55,024
3	\$0	\$0	\$34,000	\$0	\$34,000	1.0000	\$34,000	0.8163	\$27,754
4	\$0	\$0	\$34,000	\$0	\$34,000	1.0000	\$34,000	0.7629	\$25,939
5	\$0	\$0	\$34,000	\$55,000	\$89,000	1.0000	\$89,000	0.7130	\$63,457
6	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.6663	\$0
7	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.6227	\$0
8	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.5820	\$0
9	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.5439	\$0
10	\$0	\$0	\$0	\$55,000	\$55,000	1.0000	\$55,000	0.5083	\$27,957
11	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.4751	\$0
12	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.4440	\$0
13	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.4150	\$0
14	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.3878	\$0
15	\$0	\$0	\$0	\$55,000	\$55,000	1.0000	\$55,000	0.3624	\$19,932
16	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.3387	\$0
17	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.3166	\$0
18	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.2959	\$0
19	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.2765	\$0
20	\$0	\$0	\$0	\$55,000	\$55,000	1.0000	\$55,000	0.2584	\$14,212
21	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.2415	\$0
22	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.2257	\$0

Table 12-2
Summary of Cost Estimates – Selected Remedy 7 Percent Comparison Only
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Selected Remedy Excavation/Dredging, Offsite Disposal, and Monitoring						PRESENT VALUE ANALYSIS			
Site: Raritan Bay Location: Middlesex County, New Jersey Phase: Feasibility Study Base Year: 2012 Date: September 2012						Discount Rate: 7.00%			
Year ¹	Capital Costs ²	ANNUAL COSTS		PERIODIC COSTS	Total Annual Expenditure ³	Escalation Factor	Escalated Cost ⁴	Discount Factor	Present Value ^{4,5}
		O&M Costs	Monitoring Costs	Five-Year Review					
23	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.2109	\$0
24	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.1971	\$0
25	\$0	\$0	\$0	\$55,000	\$55,000	1.0000	\$55,000	0.1842	\$10,131
26	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.1722	\$0
27	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.1609	\$0
28	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.1504	\$0
29	\$0	\$0	\$0	\$0	\$0	1.0000	\$0	0.1406	\$0
30	\$0	\$0	\$0	\$55,000	\$55,000	1.0000	\$55,000	0.1314	\$7,227
TOTALS:	\$78,239,000	\$0	\$228,000	\$330,000	\$78,797,000		\$78,797,000		\$78,549,513
TOTAL PRESENT VALUE OF Selected Remedy									\$78,550,000
Notes: 1 - Duration is assumed to be 30 years for present value analysis. Estimated remedial timeframes are discussed within the FS report. 2 - Capital costs, for purposes of this analysis, are assumed to be distributed as indicated on Selected Remedy of Appendix D 3 - Total annual expenditure is the total cost per year with no discounting. 4 - Present value is the total cost per year including a discount factor for that year. See Appendix D for details. 5 - Total present value is rounded to the nearest \$1,000. Depreciation is excluded from the present value cost.									

Table 13-1a
Chemical-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARAR	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Federal	Surface Water	Clean Water Act, Ambient Water Quality Criteria (40 CFR 131)	Relevant and Appropriate	Sets criteria for water quality based on protection of human health and protection of aquatic life.	The surface water quality would be monitored to confirm that the requirement has been met.
State	Soil	NJDEP Residential Direct Contact and Non-residential Direct Contact Soil Remediation Standards (N.J.A.C. 7:26D)	Applicable	Establishes standards for soil cleanups.	The standards will be achieved through excavation and disposal in an approved off-site facility.
State	Soil	NJDEP Impact to Groundwater Soil Remediation Criteria (N.J.A.C. 7:26D)	To Be Considered	Establishes criteria for soil cleanups.	The criteria will be considered in developing the PRGs.
State	Surface Water	New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B)	Applicable	Establishes classification of surface waters of the state, procedures for establishing water quality-based effluent limitations, and modification of water quality-based effluent limitations.	Surface water would be monitored to confirm that the requirements have been met.

Table 13-1b
Location-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Coastal Zone Regulations					
Federal	Coastal Zone	Rivers and Harbors Act (33 USC 403, 33 CFR 320-330)	Applicable	This act specifies regulations for filling, altering or modifying the course, location, condition, or capacity of a navigable waterway.	This requirement will be met as part of the excavation/removal activities through permit approved by the USACE-NY district, the authority for navigable waterways at the site.
Federal	Coastal Zone	Coastal Zone Management Act (1972) and Coastal Zone Act Reauthorization Amendments (1990) (16 USC 1451 et seq.)	Applicable	This act encourages states to develop coastal management plans to manage competing uses of and impacts to coastal resources, and to manage sources of non point pollution in coastal waters.	The applicability of this requirement to the preferred alternative is currently uncertain or unknown and would be determined during the development of remedial design. Measures would be taken during the development of remedial design to plan and meet these requirements if they are applicable.
State	Coastal Zone	Tidelands Conveyances	Applicable	Tidelands grants, leases, and/or licenses are required for the use of state-owned riparian lands. These conveyances are granted by the Tidelands Resources Council.	The applicability of this requirement to the preferred alternative is currently uncertain or unknown and would be determined during the development of remedial design. Measures would be taken during the development of remedial design to plan and meet these requirements if they are applicable.
State	Coastal Zone	Coastal Zone Management Program (N.J.A.C. 7:7E)	Applicable	This program establishes standards for use and development of coastal resources in coastal waters to the limit of tidal influence.	The applicability of this requirement to the preferred alternative is currently uncertain or unknown and would be determined during the development of remedial design. Measures would be taken during the development of remedial design to plan and meet these requirements if they are applicable.
State	Coastal Zone	Coastal Permit Program Rules (N.J.A.C. 7:7)	Applicable	These rules govern the permit requirements for activities in coastal areas in the state of New Jersey.	Appropriate permits would be obtained for remedial activities that would be performed in the coastal zones as part of the preferred alternative.
State	Coastal Zone	Coastal Area Facility Review Act Permit (N.J.S.A. 13:19-1 et seq.)	Applicable	This requirement establishes that coastal areas should be dedicated to land uses that protect public health and are consistent with laws governing the environment.	Appropriate permits would be obtained for remedial activities that would be performed in the coastal zones as part of the preferred alternative.
State	Coastal Zone	Waterfront Development Upland Waterfront Permit (N.J.SA 12:5-3)	Applicable	This requirement establishes the need for permitting when constructing or developing in coastal area between mean high tide. Waterfront development activities include, but are not limited to, the construction or addition of docks, wharves, piers, bridges, pipelines, dolphins, permanent buildings, and removal or deposition of subaqueous	Appropriate permits would be obtained for remedial activities that would be performed in the coastal zones as part of the preferred alternative.

Table 13-1b
Location-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Wetlands and Flood Plains Standards and Regulations					
Federal	Wetlands and Floodplains	Statement on Procedures on Floodplain Management and Wetlands protection	Applicable	This Statement of Procedures sets forth Agency policy and guidance for carrying out the provisions of Executive Orders 11988 and 11990.	Activities under the preferred alternative will take into consideration for floodplain management and wetland protection.
Federal (Non-Regulatory)	Wetlands and Floodplains	Floodplain Management (EO 11988)	To Be Considered	Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial values of floodplains.	The potential effects of any action under the preferred alternative will be evaluated to ensure that the planning and decision making reflect consideration of flood hazards and floodplains management, including restoration and preservation of natural undeveloped floodplains.
Federal	Wetlands and Floodplains	Policy on Floodplains and Wetland Assessments for CERCLA Actions (OSWER Directive 9280.0-12, 1985)	To Be Considered	Superfund actions must meet the substantive requirements of E.O. 11988, E.O. 11990, and 40 CFR part 6, Appendix A.	Activities performed as part of the preferred alternative will take into consideration floodplain management and wetland protection.
Federal (Non-Regulatory)	Wetlands and Floodplains	Wetlands Executive Order (EO 11990)	To Be Considered	Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance natural and beneficial values of wetlands.	Remedial alternatives that involve construction would include all practicable means of minimizing harm to wetlands. Wetlands protection considerations would be incorporated into the planning and decision making of the preferred remedial alternative.
Federal	Wetlands and Floodplains	Clean Water Act (CWA) Section 404 (40 CFR parts 230 to 233)	Applicable	Under this requirement, no activity that adversely affects a wetland is permitted if a practicable alternative that does not affect wetlands is available. If no other practicable alternative exists, impacts on wetlands must be mitigated.	The effects on wetlands will be mitigated through restoration of the wetlands. Appropriate permits would be obtained prior to implementation.
State	Wetlands and Floodplains	Freshwater Wetland Protection Act (N.J.A.C. 7:7A,	Applicable	This act establishes permitting requirements for regulated activity disturbing wetlands.	This requirement would be met by obtaining all relevant permits during the implementation of the preferred alternative.
State	Wetlands and Floodplains	Wetlands Permit (N.J.S.A 13:9A-1)	Applicable	This act restricts work type and mitigative measures necessary within a wetland.	All restricted work under these requirements, if any, would be avoided within the wetland areas.
State	Wetlands and Floodplains	Flood Hazard Control Act (N.J.A.C.7:13)	Applicable	This act establishes state standards for activities within floodplains.	These requirements would be met by incorporating them into the planning and decision making of the preferred remedial alternative during the development of remedial design.
State	Wetlands and Floodplains	Flood Control Facilities Act (N.J.S.A 58:16A-50 et seq.; N.J.A.C. 7:8-3.15)	Applicable	This requirement sets standards to construct, operate, or acquire a flood control device.	These requirements would be met by incorporating them into the planning and decision making of the preferred remedial alternative during the development of remedial design.

Table 13-1b
Location-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Wildlife Habitat Protection Standards and Regulations					
Federal	Wildlife Habitat	Endangered Species Act (16 USC 1531 et seq.; 40 CFR 400)	Applicable	This requirement establishes standards for the protection of threatened and endangered species.	This requirement will be considered during the development of alternatives.
Federal	Wildlife Habitat	Fish and Wildlife Conservation Act (16 USC 2901 et seq.)	To Be Considered	This act protects and conserves nongame fish and wildlife.	This requirement will be considered during the development of alternatives.
Federal	Wildlife Habitat	Fish and Wildlife Coordination Act (16 USC 661)	To Be Considered	This act maintains and coordinates wildlife conservation.	This requirement will be considered during the development of alternatives.
Federal	Wildlife Habitat	Migratory Bird Treat Act (MBTA, 1 U.S.C. 03 et seq.)	Applicable	The selected remedial action(s) must be carried out in a manner that avoids the taking or killing of protected migratory bird species, including individual birds or their nests or eggs.	This requirement will be considered during the development of alternatives.
Federal	Wildlife Habitat	Magnuson-Stevens Fishery Conservation and Management Act	Applicable	Raritan Bay is a designated Essential Fish Habitat (EFH) for one or more species, which may require an EFH assessment.	If there are no substantial impacts to EFH from any future proposed remedy, the site contractor may only need to complete and submit an EFH worksheet. However, if there are potential significant impacts to the EFH from project activities, the site contractor will have to prepare an EFH assessment. The final determination on the applicability of this requirement would be made during the remedial design and would be complied with during implementation.
State	Wildlife Habitat	New Jersey Endangered and Nongame Species Conservation Act	Applicable	This act protects and conserves endangered and nongame species.	Threatened or endangered species would be protected during remediation.
Cultural Resources, Historic Preservation Standards and Regulations					
Federal	Cultural Resources and Historic Preservation	National Historic Preservation Act (40 CFR 6.301)	Applicable	This requirement establishes procedures to provide for preservation of historical and archeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	The effects on historical and archeological data will be evaluated during the identification, screening, and evaluation of alternatives.

Table 13-1c
Action-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Principal Threat Waste					
Federal	All media - principal threat waste	A Guide to Principal Threat and Low Level Threat Wastes (OSWER 9380.3-06FS)	To be Considered	This guidance outlines considerations for Sites that involve significant amount of hazardous wastes that act as source of contamination for other media such as surface water and groundwater	The guidance recommends treatment of principal threat wastes. However, since treatment may not be entirely effective at the Site, all contaminated materials (including principal threat waste material) at the Site would be removed from existing locations. Any hazardous material would be treated at the disposal facility to meet disposal requirements.
General Site Remediation					
Federal	NA	OSHA Recording and Reporting Occupational Injuries and Illnesses (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the companies contracted to implement the remedy. All applicable requirements will be met.
Federal	NA	OSHA Occupational Safety and Health Standards (29 CFR 1910)	Applicable	These regulations specify an 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below the 8-hour time-weighted average at these specified concentrations.
Federal	NA	OSHA Safety and Health Regulations for Construction (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on site, and appropriate procedures will be followed during remediation activities.
Federal	All media	RCRA Identification and Listing of Hazardous Wastes (40 CFR 261)	Applicable	This regulation describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation is applicable to the identification of hazardous wastes that are generated, treated, stored, or disposed during remedial activities.
Federal	NA	RCRA Standards Applicable to Generators of Hazardous Wastes (40 CFR 262)	Applicable	Describes standards applicable to generators of hazardous wastes.	Standards will be followed if any hazardous wastes are generated onsite.
Federal	NA	RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – General Facility Standards (40 CFR 264.10–264.19)	Relevant and Appropriate	This regulation lists general facility requirements including general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
Federal	NA	RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Preparedness and Prevention (40 CFR 264.30–264.37)	Relevant and Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
Federal	NA	RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Contingency Plan and Emergency Procedures (40 CFR 264.50–264.56)	Relevant and Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Emergency Procedure Plans will be developed and implemented during remedial action. Copies of the plans will be kept on site.
State	All media	New Jersey Technical Requirements for Site Remediation (N.J.A.C. 7:26E)	Applicable	This regulation provides the minimal technical requirements to investigate and remediate contamination at the site.	The regulation will be applied to any hazardous waste operation during remediation of the site.

Table 13-1c
Action-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
State	NA	New Jersey Uniform Construction Code (N.J.A.C. 5:23)	Applicable	This code provides the requirement for construction performed during remediation of the site.	This code will be applied to any construction performed during remediation of the site.
State	NA	New Jersey Hazardous Waste Regulations - Identification and Listing of Hazardous Waste (N.J.A.C. 7:26G-5)	Applicable	This regulation describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation will be applicable to the identification of hazardous wastes that are generated, treated, stored, or disposed during remedial activities and will be met through identification by laboratory analysis.
State	Soil and Sediment	New Jersey Soil Erosion and Sediment Control Act (N.J.A.C. 2:90)	Applicable	This act outlines the requirements for soil erosion and sediment control measures.	This act will be incorporated during development of remedial design.
State	Soil and Sediment	Freehold Soil Conservation District Soil Erosion and Sediment Control (SESC) Plan Certification	Applicable	A SESC plan certification is required by the local soil conservation office for any project that disturbs more than 5,000 square feet of surface area of land.	This act will be incorporated during development of remedial design.
State	Groundwater/ Surface water	New Jersey Bureau of Water Allocation Temporary Dewatering Permit equivalency (N.J.A.C. 7:19)	Applicable	A temporary dewatering permit for containment cell construction will be required for the withdrawal of ground and/or surface water in excess of 100,000 gallons of water per day for a period of more than 30 days in a consecutive 365 day period, for purposes other than agriculture, aquaculture or horticulture. For dewatering in excess of 100,000 gallons of water per day, the project owner must obtain a Temporary Dewatering Allocation Permit, or Dewatering Permit-by-Rule or Short Term Permit-by-Rule depending on the duration of construction and the method employed.	Appropriate permit would be obtained prior to the implementation of remedial activities.
State	Noise	New Jersey Noise Control (N.J.A.C. 7:29)	Applicable	This standard provides the requirement for noise control.	This standard will be applied to any remediation activities performed at the site.
Waste Transportation					
Federal	All media	Department of Transportation (DOT) Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171, 172, 177 to 179)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting hazardous materials.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
Federal	All media	RCRA Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)	Applicable	Establishes standards for hazardous waste transporters.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
State	All media	New Jersey Transportation of Hazardous Materials (N.J.A.C. 16:49)	Applicable	Establishes record keeping requirements and standards related to the manifest system for hazardous wastes.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
Waste Disposal					
Federal	Solid Wastes	RCRA Land Disposal Restrictions (40 CFR 268)	Applicable	This regulation identifies hazardous wastes restricted for land disposal and provides treatment standards for land disposal.	Hazardous wastes will be treated to meet disposal requirements at the approved disposal facility.
Federal	NA	RCRA Hazardous Waste Permit Program (40 CFR 270)	Applicable	This regulation establishes provisions covering basic EPA permitting requirements.	All permitting requirements of EPA would be complied with.
State	All applicable media	New Jersey Hazardous Waste (N.J.A.C. 7:26C)	Applicable	These regulations establish rules for the operation of hazardous waste facilities in the state of New Jersey.	All remedial activities would adhere to these regulations while handling hazardous waste during remedial operations.

Table 13-1c
Action-Specific ARARs, Criteria, and Guidance for Selected Remedy
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

Authority	Medium	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
Water Discharge or Subsurface Injection					
Federal	Surface water	National Pollutant Discharge Elimination System (NPDES) (40 CFR 100 et seq.)	Relevant and Appropriate	NPDES permit requirements for point source discharges must be met, including the NPDES Best Management Practice Program. These regulations include, but are not limited to, requirements for compliance with water quality standards, a discharge monitoring system, and records maintenance.	Project will meet NPDES permit requirements for point source discharges.
Federal	Groundwater/ Surface water	Effluent Guidelines and Standards for the Point Source Category (40 CFR 414)	Applicable	These regulations establish effluent limitations on direct discharge and indirect discharge point sources.	Project will meet the standards for the point source category.
Federal	Surface water	Ambient Water Quality Criteria (40 CFR 131.36)	Applicable	Establishes toxics criteria for those states not complying with Clean Water Act section 303(c)(2)(B)	The criteria will be considered during the evaluation of discharge practices during the remedial action.
Federal	Surface water	Clean Water Act (CWA) Section 404 (40CFR Parts 230-233)	Applicable	This requirement restricts discharge of dredged or fill material to wetlands or waters of the United States. Provides permitting program for situations with no other practical alternative. Additionally, when remediating the jetty and seawall, an engineering analysis will be needed before the USACE will grant a permit.	This requirement will be met by evaluation of the impacts of activities during remedial design and by obtaining appropriate permits.
State	Surface water	The New Jersey Pollutant Discharge Elimination System (N.J.A.C. 7:14A)	Applicable	This permit governs the discharge of any wastes into or adjacent to State waters that may alter the physical, chemical, or biological properties of State waters, except as authorized pursuant to a NPDES or State permit.	Project will meet NPDES permit requirements for surface discharges of the water from dewatering activities.
Off-Gas Management					
Federal	Air	Clean Air Act (CAA)—National Ambient Air Quality Standards (NAAQs) (40 CFR 50)	Applicable	These provide air quality standards for particulate matter, lead, NO ₂ , SO ₂ , CO, and volatile organic matter.	During excavation, treatment, and/or stabilization, air emissions will be properly controlled and monitored to comply with these standards.
Federal	Air	Standards of Performance for New Stationary Sources (40 CFR 60)	Applicable	Set the general requirements for air quality.	During excavation, treatment, and/or stabilization, air emissions will be properly controlled and monitored to comply with these standards.
Federal	Air	National Emission Standards for Hazardous Air Pollutants (40 CFR 61)	Applicable	These provide air quality standards for hazardous air pollutants.	During excavation, dredging or other activities as part of the preferred alternative, air emissions will be properly controlled and monitored to comply with these standards.
State	Air	New Jersey Air Pollution Control Act (N.J.A.C. 7:27)	Applicable	Describes requirements and procedures for obtaining air permits and certificates; rules that govern the emission of contaminants into the ambient atmosphere.	During excavation, dredging or other activities as part of the preferred alternative, air emissions will be properly controlled and monitored to comply with these standards.
State	Air	New Jersey Ambient Air Quality Standards (N.J.A.C. 7:27-13)	Applicable	This standard provides the requirement for ambient air quality control.	This standard will be applied to any remediation activities performed at the site.

APPENDIX C – Proposed Plan

Raritan Bay Slag Superfund Site
Townships of Old Bridge/Sayreville, New Jersey

September 2012



EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the preferred alternative for addressing the site-wide soils and sediments at the Raritan Bay Slag Superfund Site and provides the rationale for those preferences.

The U.S. Environmental Protection Agency's (EPA's) Preferred Alternative includes excavation/dredging, off-site disposal, institutional controls and long-term monitoring. Slag, battery casing/associated wastes, contaminated soils and sediments above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate in excavated Margaret's Creek upland areas. Soils and sediments have been found to be contaminated with heavy metals from erosion of particulates and leaching from slag and battery casings/associated wastes. The Preferred Alternative incorporates cleanup actions to complete the response action at the site.

EPA is proposing active measures to address the site-wide contaminated soils and sediments as the preferred alternative. EPA is recommending Remedial Alternative 2, identified as Excavation/Dredging, Off-site Disposal, and Long-Term Monitoring.

This Proposed Plan summarizes the data and rationale considered in making this recommendation. This document is issued by EPA, the lead agency for site activities. EPA, in consultation with the New Jersey Department of Environmental Protection (NJDEP), the support agency for site activities, will select the remedy for the Site after reviewing and considering all information submitted during a 30-day public comment period. EPA, in consultation with NJDEP, may modify the preferred alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the information presented in this Proposed Plan.

EPA is issuing this Proposed Plan as part of its community relations program under Section 117(a) of Comprehensive

MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD:

September 28, 2012 through October 29, 2012, U.S. EPA will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING:

October 17, 2012, at 7:00 P.M.

U.S. EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at the:

George Bush Senior Center
1 Old Bridge Plaza
Old Bridge, NJ 08857

For more information, see the Administrative Record at the following locations:

U.S. EPA Records Center, Region 2

290 Broadway, 18th Floor
New York, New York 10007-1866
(212) 637-4308
Hours: Monday-Friday, 9 AM to 5 PM

Old Bridge Central Library

1 Old Bridge Plaza
Municipal Center
Old Bridge, NJ 08857
Hours: Monday - Friday 9:30 AM - 9 PM
Saturday 9:30 AM - 5 PM, Sunday 12:30 - 5 PM

Sayreville Library

1050 Washington Rd.
Parlin, NJ 08859
(732) 727-0212
Hours: Monday -Tuesday 9:30 AM - 7:45 PM
Friday and Saturday 9:30 - 4:45 PM, Sunday 1 - 4:45 PM

N.J. Department of Environmental Protection

401 East State Street, Trenton, New Jersey

Bridgewater Township Library

1 Vogt Drive, Bridgewater, New Jersey

Environmental Response, Compensation and Liability act (CERCLA, or Superfund). This Proposed Plan summarizes

information that can be found in greater detail in several reports included in the Administrative Record.

SITE DESCRIPTION

The site is located on the shore of Raritan Bay, in the eastern part of Old Bridge Township within the Laurence Harbor section in Middlesex County, New Jersey. A small portion of the western end of the site, the western jetty at the Cheesequake Creek Inlet, is located in the Borough of Sayreville. The site is bordered to the north by Raritan Bay and to the east, west, and south by residential properties (Figure 1).

The site is approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. The portion of the site in Laurence Harbor is part of Old Bridge Waterfront Park. The park includes walking paths, a playground area, several public beaches, and three jetties, not including the two jetties (western jetty and eastern jetty) at the Cheesequake Creek Inlet. The park waterfront is protected by a seawall, which is partially constructed with pieces of waste slag from a secondary lead smelter. The western jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty are located in Sayreville. Slag has been placed on top of the western jetty and is observed along the adjoining waterfront. Slag was also observed in the Margaret's Creek area, an undeveloped 47-acre wetland located southeast of the seawall in Laurence Harbor.

The site has been divided into 11 Site Areas for ease of discussion based on areas identified in historical investigations, site physical characteristics, and the locations of known or potential sources. The 11 Site Areas are shown on Figure 2. Discussions are organized into three sectors based on the type of environment and proximity to source areas; sectors include the Seawall Sector (Areas 1, 2, 3, 4, 5, and 6), the Jetty Sector (Areas 7, 8, and 11), and the Margaret's Creek Sector (Area 9 which consists of a wetlands portion and an upland portion). Area 10, a non-impacted area located to the east of the site, was used to collect background samples.

SITE HISTORY

The slag was deposited at the beachfront in the late 1960s and early 1970s, mostly in the form of blast furnace pot bottoms or kettle bottoms from a secondary lead smelter, in an area that had sustained significant beach erosion and damage due to a series of storms in the 1960s. Demolition debris in the form of concrete and a variety of bricks, including fire bricks, was also placed along the beachfront.

A portion of the seawall also contains large riprap believed to have been placed over the slag when the grassed and paved portion of the park was developed.

The western jetty at Cheesequake Creek Inlet is part of a federally authorized navigation project by the United States Army Corps of Engineers (USACE) and has been in existence since the USACE constructed it in the late nineteenth century. The slag is believed to have been placed on the western jetty during the same general time period as the construction of the seawall. The entire western jetty is covered with slag that is similar in appearance to the slag on the seawall. The slag was used to supplement the jetty and as fill/stabilizing material for the seawall.

Elevated levels of lead, antimony, arsenic, copper, and chromium were identified by NJDEP in soil along the seawall in 2007 and at the edge of the beach near the western end of the seawall. Old Bridge Township placed a temporary "snow" fence in this area, posted "Keep-off" signs in the park along the split rail fence that borders the edge of the seawall, and notified the residents of Laurence Harbor.

EPA collected samples at the site in September 2008 as part of an Integrated Assessment. The purpose of this sampling event was to determine whether further action under CERCLA was needed. The sampling included the collection of soil, sediment, surface water, biological, and slag samples along the seawall in Laurence Harbor, the western jetty at the Cheesequake Creek Inlet, the beaches near these two locations, and the developed portion of the park. EPA and NJDEP analytical results determined that significantly elevated levels of lead and other heavy metals are present in the soils, sediment, and surface water in and around both the seawall in Laurence Harbor and the western jetty at the Cheesequake Creek Inlet.

At EPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the seawall in Laurence Harbor, the beach between the western end of the seawall and the first jetty, and the western jetty at the Cheesequake Creek Inlet, including the waterfront area immediately west of the inlet (ATSDR 2009). As a result of this determination, EPA's Removal Action Branch conducted a removal action to restrict access to these areas (by installing permanent fences and posting signs) and provided public outreach to inform residents and those using these areas of the health hazard that exists. On April 24, 2008, EPA received a request from NJDEP to evaluate the Laurence Harbor seawall for a removal action

under CERCLA. On November 3, 2008, NJDEP forwarded an amended request to include the western jetty along the Cheesequake Creek Inlet as part of the overall site. In March 2009, the 47-acre property associated with Margaret's Creek was also included in the overall site. The site was listed on the National Priorities List in November 2009.

SITE CHARACTERISTICS

The site consists of a waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. It is located on the shore of Raritan Bay.

Topography and Bathymetry

The site topography is characterized by a gradual rise along the beach to shore bluffs. The bluffs extend the length of the site along the Bay except for Area 9, in front of the Margaret's Creek wetlands. The elevation at the top of the shore bluffs is about 30 feet above mean sea level. South of the bluffs, the terrain is primarily flat.

The Raritan Bay bathymetry near the beach is characterized by a very gradual seaward slope. A significant ebb shoal (shallow depositional area) has built up near the mouth of Cheesequake Creek. North of this ebb shoal, the depth increases sharply.

Surface Water Hydrology, Floodplain and Wetlands

Surface water drainage in the vicinity of the site is toward tidal creeks, the bay and their associated wetlands. The major surface water bodies at the site include Raritan Bay, Cheesequake Creek, and Margaret's Creek. These water bodies are subject to tidal fluctuations averaging 5.5 feet. Because the slope of the Raritan Bay floor is very gentle, 400 to 600 feet of the Bay floor are exposed during low spring tide.

The entire site, except for small portions of the upland areas in Margaret's Creek Sector, is within zones of high or moderate flooding. Wetlands at the site are all sub-tidal or intertidal estuarine habitats. The wetlands of Margaret's Creek are a mixture of unconsolidated shore with organic soil and emergent wetlands that are vegetated and partially flooded.

Sediment Characteristics

The beach areas are sandy with little organic carbon. Upland of the beaches, soils are more organic-rich and contain a higher proportion of silt and clays. The sub-tidal and intertidal areas along Raritan Bay are predominantly sandy, with little silt, clay, or organic carbon.

Sediment Dynamics

In Raritan Bay, wave-driven and tidal currents transport sediment. Storms can increase the quantity of sediment currents transport by up to a factor of four (Woods Hole Group [WHG], 2011). Across most of the shoreline, non-cohesive sand on beaches and on the Bay floor is readily mobilized into currents. The seawall and revetment (Area 6) limit sand supply.

Since the Bay shoreline is relatively quiet and protected from ocean swells, significant waves and mixing occur only during storm events. Wave-induced mixing is expected to be prominent on beaches and could result in contamination being present at depth on beaches. Cohesive sediments and lower-energy environments are present in the lee (western side) of the Cheesequake Creek western jetty, limiting sediment erosion and mixing.

Jetties along Raritan Bay affect sediment transport. The lee side of the Cheesequake Creek western jetty is a very low energy environment protected from waves and storms. Depositional areas are present just off the eastern Cheesequake Creek jetty. A depositional shoal is also present offshore of the mouth of Margaret's Creek. A dynamic mixing zone is present just offshore of the Cheesequake Creek western jetty with irregular accumulation and sediment is rearranged frequently.

Geochronology studies, designed to assess the rate of deposition, were conducted in the Margaret's Creek wetlands because it is relatively protected from the wind and waves that would disturb sediment stratigraphy. Geochronology cores were not collected off-shore because it is a dynamic wave influenced area with no undisturbed sediment. Data show that sediment deposition is actively occurring across the open water portions of the wetlands.

GEOLOGY AND HYDROGEOLOGY

Geology

The site is located in the Coastal Plain Physiographic Province of New Jersey, a seaward-sloping wedge of unconsolidated sediments ranging in age from Cretaceous to Holocene. The coastal plain sediments are composed of clay, sand, silt, and gravel, and are overlain by Quaternary age deposits. In the vicinity of the site, the Quaternary deposits are underlain by the Upper Cretaceous age Magothy and Raritan Formations which are, in turn, underlain by the Lower Cretaceous age Potomac Group.

Hydrogeology

The site is located within the Raritan River Basin. This Basin is bounded by the Passaic River Basin to the north, Delaware River Basin to the west and Atlantic Coastal

Basin to the south. The major aquifer system in this region is the New Jersey Coastal Plain Aquifer System.

Hydrodynamics

Since Raritan Bay is relatively calm during normal conditions, the majority of sediment movement occurs during storms. Waves in the Bay originate predominantly from the east and northeast (Atlantic Ocean). Thus, contaminants from the seawall and the Margaret's Creek area tend to migrate westward toward the western jetty. Currents near the Cheesequake Creek Inlet and western jetty are complex due to the strong dominant tidal currents within Cheesequake Creek. Per tidal cycle, more water and sediment exit Cheesequake Creek than enters. In Margaret's Creek, the regular flow of water through the wetlands produces minimal currents, although storm surges could produce stronger currents.

Groundwater and Surface Water Interaction

Groundwater and surface water interaction at the site were evaluated by collecting a series of synoptic water level measurements from all monitoring wells and staff gauges. Continuous water level data from selected monitoring wells was also collected.

At the western end of the seawall, under low tide conditions, groundwater flow is toward the Bay. Under high tide conditions, the overall groundwater flow direction is also toward the Bay, but the flow is more complex due to the influence of tides and the vertical gradient. Flow in the deeper zone tends to stagnate on the inland side of the seawall while shallow groundwater flow is still toward the Bay. The eastern end of the seawall at low and high tide shows a simpler relationship between groundwater elevation and tidal elevation; lateral groundwater flow at low tide is toward the Bay while at high tide, lateral groundwater flow is inland.

Near the foot of the Cheesequake Creek western jetty, the deep and shallow water levels were essentially the same. They both fluctuated about 6 feet in response to tidal changes in the channel on one side and beach on the other side.

In the Margaret's Creek area about 250 feet to 1,200 feet inland from the Bay, no significant tidal influence was noted. However, the difference in water level elevation along this section is about 4 feet. This observation indicates that there is a consistent component of shallow groundwater flow toward the Bay in this area.

ADDITIONAL INVESTIGATIONS

Remedial Investigation (RI) field activities were conducted from September 2010 through June 2011. Activities focused

on collecting sufficient data to fill gaps in the existing data as identified in the Final (Revised) Data Gap Evaluation Technical Memorandum (CDM Smith 2010). The major elements of the field investigation are outlined below.

Survey and Study Activities

Topographic and bathymetric surveys were conducted to provide information on the geometry and physical features of the Raritan Bay floor, beaches, and upland areas, including the surrounding residential communities. The data were used to delineate the upland and intertidal zones.

- Hydrodynamics and sediment dynamics studies were conducted to provide data on currents and sediment transport in the nearshore environment of Raritan Bay.
- A slag distribution study and a slag survey were conducted to define the distribution of slag at the site. The slag distribution study included test excavations to identify the buried slag in the vicinity of the seawall. The slag survey was conducted to visually identify and estimate the volume of slag and battery casings at the seawall, beachfront areas, western jetty, and Margaret's Creek area.
- Exchange studies were conducted in the Cheesequake Creek Inlet and Margaret's Creek to estimate the exchange (flux) of contaminants between the creeks and the bay.
- A hydrogeologic assessment was conducted to provide the data to evaluate geologic and hydrogeologic conditions at the site and included:

Monitoring Wells – A total of 15 shallow and 6 deep wells were installed in the overburden to determine the groundwater flow direction, horizontal and vertical hydraulic gradients, tidal effects, and establish baseline groundwater quality (FS Figure 1-21).

Groundwater and Surface Water Interaction - Continuous water level measurements were recorded in 15 monitoring wells for a period of one month. To document long-term changes in groundwater elevations, six rounds of synoptic water level measurements were taken from February to June 2011.

- A Stage IA cultural resources survey was conducted to identify any cultural or archeological resources within the study area. The survey excluded areas of Margaret's Creek where previous Stage 1A and Stage 1B cultural resources surveys were conducted by Old Bridge Municipal Utilities Authority. Several moderate to high archaeological sensitive locations were identified within or border the site. Additional surveys may be performed during the remedial design to confirm if they are archaeological sensitive

locations. These locations are not expected to be impacted by activities at the site.

- An ecological characterization survey was conducted to characterize habitats in the study area and to identify threatened and endangered species. The survey covered the uplands, beaches, and nearshore environment of Raritan Bay.

Seawall Sector Samples

The Seawall Sector (Areas 1, 2, 3, 4, 5, and 6) samples were collected from upland, beach, and tidal areas potentially impacted by slag material in and around the seawall. A total of 291 sediment samples, 219 soil samples, and 37 surface water samples were collected from the Seawall Sector.

Jetty Sector Samples

The Jetty Sector (Areas 7, 8, and 11) samples were collected from upland, beach, and tidal areas potentially impacted by slag material in and around the western Cheesequake Creek Inlet Jetty. A total of 165 sediment samples, 52 soil samples, and 25 surface water samples were collected from the Jetty Sector.

Margaret's Creek Sector Samples

The Margaret's Creek Sector (Area 9) samples were collected from upland, beach, and wetland areas potentially impacted by fill material. A total of 184 sediment samples, 276 soil samples, and 21 surface water samples were collected from the Margaret's Creek Sector.

Groundwater Samples

One round of groundwater samples was collected from 21 monitoring wells installed during the field investigation. Wells MW-10S and MW-10D were subsequently resampled to confirm previous lead results.

Biota Samples

Biological samples included blue crabs, hard clams, ribbed mussels, killifish, long neck clams, sea lettuce and six species of game fish across the site.

Bioavailability Samples

Forty soil samples were collected from Areas 2, 3, 5, 6, and 9 for in-vitro bioavailability and electron microprobe analysis for lead and arsenic.

Technical Review Workshop Lead Composite Samples

EPA's Lead Technical Review Workgroup (TRW) has specific guidance on lead sampling. Composite soil samples were collected from 203 locations above the spring low tide line and analyzed for lead. Each composite consisted of five subsamples collected within a 50-foot radius of a center point at a depth of 0-2 inches to be representative of soil that is likely to be ingested.

Background Samples

Sediment, surface water, soil, and groundwater samples were collected to develop site-specific background concentrations. Forty-nine background sediment, 25 background soil samples, and 11 background TRW samples were collected from Area 10. Twelve background surface water samples were collected from Raritan Bay. Background groundwater samples were collected from monitoring well MW-11S, located upgradient of the site wells.

NATURE AND EXTENT OF CONTAMINATION

The evaluation of the nature and extent of contamination focused on those constituents identified as site-related contaminants (i.e., lead, arsenic, copper, antimony, chromium, and iron) in site sediment, surface water, soil, and groundwater. Conservative, health-protective preliminary screening criteria were used in the initial step to identify the nature and extent of contamination in site media. It is important to note that concentrations that exceeded these preliminary screening criteria are not necessarily associated with unacceptable risk to human health or the environment, but are used to define the areas that required further evaluation.

Selection of Site - Related Contaminants

To provide a focused assessment of the large quantity of analytical data, several key contaminants were identified and used in previous reports and the RI report. The metals lead, arsenic, copper, antimony, chromium, and iron are known to be associated with the slag source material and were detected frequently in all media and often at elevated levels. Of particular importance is lead, which was identified as contributing significantly to potential risk in the media evaluated at the site.

Other metals, including, cadmium, cobalt, nickel, selenium, silver, thallium, tin, and zinc, were found in varying but lower proportions in slag. These metals did not drive human health or ecological risks and were detected less frequently than the site-related contaminants that were used to evaluate contamination at the site.

Background Samples

Sediment, surface water, soil, and groundwater samples were collected and site-specific background concentrations for metals in sediment (both Bay and wetlands) and soil were developed for use in the Feasibility Study (FS).

Area 10 was selected as the background location for soils, surface water, and sediments. For wetland sediments, Whaler's Creek was identified as the background location. This area is located out of the watershed and is not impacted

or influenced by the site. Sediments collected from Whaler's Creek were used for ecological risk purposes only.

Test Excavations

Slag was observed in 7 of the 26 test excavations in Areas 1 and 4. Slag depths ranged from 1 to 5 feet below ground surface (bgs). Most of the slag observations were along or near the seawall. In general, lead, arsenic, copper, antimony, and chromium exceeded their respective screening criteria in test pit samples collected along or near the seawall.

Arsenic also exceeded its screening criterion in one sample collected from the beach in Area 2.

Slag Leaching Tests

Slag samples and slag cores were subjected to a variety of leaching tests (Schnabel 2011 provided in Appendix B of the FS), including synthetic precipitation leaching procedure (SPLP), toxicity characteristic leaching procedure (TCLP), semi-dynamic leach and de-ionized water (DIW) using the SPLP procedure. These various leaching tests confirm that lead is leachable from the slag under different conditions. Concentrations of lead in both composite and core slag samples were identified at levels ranging from 38,000 mg/kg to 91,000 mg/kg.

Leachability from the slag was also examined in a neutral salt extraction procedure, used to simulate conditions in which slag is exposed to seawater. Under these conditions, lead was determined to be leachable while arsenic, copper, antimony, and tin did not leach. It was demonstrated that core samples had considerably higher levels of leachable lead than exterior slag samples but levels from both core and exterior samples were above the drinking water Maximum Contaminant Level (MCL). These leaching tests show that if the slag comes into contact with fresh or salt water, it will leach lead. As a result, the slag must be chemically stabilized to minimize the leaching potential. The potential for the slag to contact water must be minimized, or leachate from the slag must be prevented from discharging into the environment.

Battery Casing Leaching Tests

TCLP tests were conducted on the battery casings by analyzing three composite samples from battery casing piles in the upland area of the Margaret's Creek Sector, the Area 2 beach, and the landward end of the western jetty. Lead was the only metal to leach in significant quantities. Samples from the Area 2 beach were below the 5.0 milligram per liter (mg/L) regulatory TCLP limit. Samples from the Margaret's Creek Sector and western jetty composite samples were both above the TCLP limit.

Slag Survey / Battery Casing Survey

Slag and battery casing surveys were conducted at the western jetty, seawall, and Margaret's Creek Sector to determine slag and/or battery casing distribution and

volumes. The survey was conducted through visual observation only. The estimated volume of slag for the western jetty is 5,000 cubic yards (CY). The estimated volume of slag for the seawall is 5,300 CY. The estimated volume of battery casings for the beachfront is 70 CY. The estimated volume of slag for Margaret's Creek Sector is 470 CY and of battery casings is 250 CY. The locations of the slag and battery casings (source material) are shown in Figures 3-6.

Summary of Seawall Sector

The primary sources of site-related metals contamination are slag and battery casings. The seawall is up to 80 percent slag. Battery casings were found in the upper two inches of depositional zones in Areas 2 and 5. Buried slag was observed in test excavations on the upland side of the seawall in Area 1 and the eastern end of Area 4.

Generally, site-related soil and sediment contamination in the Seawall Sector is defined by co-located lead and arsenic contamination exceeding the screening criteria in specific depositional areas (Areas 2 and 5) and in areas associated with slag.

Along the eastern 1,000 feet of the seawall, co-located lead and arsenic that exceeded the preliminary screening criteria occur along the mean high tide line. Most of the contamination in this area is in the shallow soils and sediment. In Area 2, in the soils and near-shore sediments, lead and arsenic concentrations both exceeded the preliminary screening criteria. Deeper soils in this area also exceeded both the lead and arsenic human health screening criteria. In Area 5, near the first jetty, co-located lead and arsenic in soil and sediment exceeded the initial screening criteria. Deeper soil and sediment from this area did not.

Other site-related metals were detected at some locations where lead and arsenic contamination were not co-located.

In surface water, lead was commonly detected above the site-specific screening criterion in surface water samples collected from the intertidal zone, between the eastern end of Area 1 and the western end of Area 6; the highest concentrations were in Areas 1 and 2. Arsenic was detected above its site-specific screening criterion less frequently than lead.

Summary of Jetty Sector

The western jetty and adjacent areas contain slag and some battery casings. The western side of the western jetty and the adjacent shoreline are comprised of 80 to 90 percent slag. The prevailing currents in the vicinity of the western jetty promote sediment deposition on the western side of the jetty and transport of sediment into Raritan Bay. The

fine-grained organic rich sediments in this area tend to sorb metals.

The highest concentrations of lead and arsenic in the Jetty Sector sediments, soils, and surface water were located on and to the west of the western jetty. Sediment contamination, initially defined by the co-location of lead and arsenic that exceeded preliminary site-specific screening criteria, included the area from the western jetty westward approximately 200 feet into Area 8, and seaward of the western jetty in Area 7. Co-located soil and sediment lead and arsenic above the preliminary site-specific screening criteria extended 1,000 feet northwest of the western jetty and westward along the shore into Area 11. In Area 11, co-located lead and arsenic contamination was found along the mean high tide line and the intertidal zone. The vertical extent of sediment contamination along the entire length of the jetty has not been fully delineated, but the horizontal extent of deeper contamination is bounded to the west.

Concentrations of lead and arsenic in soils in the Jetty Sector exceeded preliminary site-specific soil screening criteria. The shallow soils most impacted by site-related metals were on and adjacent to the western jetty. In deeper soils, lead and arsenic concentrations exceeding the preliminary site-specific screening criteria are limited to the western jetty and Area 8 beach.

The majority of surface water samples collected from the Jetty Sector did not exceed screening criteria. However, two surface water samples in the Jetty Sector exceeded the site-specific screening criteria for lead and arsenic.

Cheesequake Creek Inlet Exchange Study Results

The exchange study was conducted to estimate the flux of contaminants through the Cheesequake Creek Inlet. Contaminant flux for various flood tidal stages was estimated using Cheesequake Creek flow measurements and lead, arsenic, copper, antimony, and chromium data for surface water samples.

The concentrations of site-related metals in the inlet surface water were much lower than other areas of the site. In terms of bulk sediment and water, Cheesequake Creek was determined to be a net exporter of both sediments and water into Raritan Bay.

Summary of Margaret's Creek Sector

Sediment samples with co-located lead and arsenic that exceeded the preliminary site-specific screening criteria were limited to the shallow wetland areas. The co-location of lead and arsenic in sediment that exceeded the human health screening criteria was limited to one location. In deep sediments, co-located arsenic and lead concentrations above

the preliminary site-specific screening criteria were limited to two widely-separated locations. Both of the high-resolution contaminant analysis cores showed that, in the top eight inches of core, both arsenic and lead exceeded the initial human health screening criteria.

No primary sources (e.g., slag or battery casings) were observed in the wetland sediment, which suggests that the source of sediment contamination is weathering of slag and battery casings and storm water runoff from upland sources. Contaminants are dispersed widely across the wetlands, and contamination is generally present only in the top 24 inches.

Two surface water samples collected from inside the Margaret's Creek channel exceeded surface water criteria for lead and arsenic. In the western, open-water portion of the wetlands, two surface water samples exceeded the site-specific levels for lead. No surface water samples in the eastern, open-water area exceeded any screening criteria. In Raritan Bay samples in the vicinity of Margaret's Creek, lead in surface water samples were detected above the site-specific screening levels.

In soils, co-located lead and arsenic that exceeded the preliminary site-specific screening criteria were identified in nine samples: one on the dunes, two adjacent to Area 1, and six in upland soils. Four shallow soil samples contained co-located arsenic and lead above the human health screening criteria. Two subsurface locations in the upland area exceeded the human health screening criteria for co-located lead and arsenic. The highest concentration of lead was located in the sample adjacent to Area 1.

The observed distribution of soil contamination is consistent with a model of non-contiguous "hot spots" rather than area-wide contamination. This finding is consistent with observations that sporadic dumping of waste on the ground surface occurred in the upland areas of Margaret's Creek.

Margaret's Creek Exchange Study Results

The Margaret's Creek exchange study evaluated the exchange of contaminants and sediment between the Margaret's Creek wetlands and Raritan Bay via Margaret's Creek (i.e., water and sediment flux). Water and sediment exchange in Margaret's Creek does not occur on a regular basis since the Margaret's Creek wetlands are at a higher elevation than mean high tide. Therefore, flux out of Margaret's Creek into Raritan Bay was measured. The average daily contaminant flux calculated from Margaret's Creek entering Raritan Bay was approximately 19.1 grams (g) of lead per day. The dissolved portion of the lead flux is estimated not to exceed 6.6 g per day. Margaret's Creek is a very small net exporter of contaminants and sediments into Raritan Bay.

Groundwater Sampling Results

Groundwater samples were collected from 21 monitoring wells in January 2011, and in April 2011 from one well pair (MW-10S and MW-10D, to confirm lead results). MW-11S was installed at an upgradient location to monitor background conditions.

In background well MW-11S, aluminum, arsenic, iron, lead, manganese, and sodium exceeded their respective screening criteria, indicating that some of the concentrations above site-specific screening criteria in the other samples may not be related to site sources. Lead exceeded the site-specific screening criterion (5 micrograms per liter [$\mu\text{g/L}$]) in nine monitoring wells (excluding the background well). These wells are clustered around the three source areas: the western jetty, the seawall, and Margaret's Creek.

Several monitoring wells across the site contain naturally-occurring concentrations of cobalt, iron and/or arsenic that are impacting groundwater quality as a result of background or natural geochemical conditions.

Groundwater in the area containing monitoring wells MW-07S-R1, MW08D-R1, MW-08S-R1, MW-09S-R1, MW-10D-R1, MW-10S-R1, and MW-12S-R is classified as Class III-B. This classification means that the groundwater is unsuitable for potable use, based in part on the presence of elevated levels of salinity and total dissolved solids that meet both federal and state guidelines for Class III-B aquifers. Groundwater is not currently used for drinking water at the site and future potable use of groundwater in the Class III-B portion of the aquifer is prohibited. Residents in the area are connected to the municipal water supply system for their drinking water.

SCOPE AND ROLE OF ACTION

EPA's preferred remedy to address contamination at the site is removal of slag, battery casings/associated wastes, soil/sediment above remediation cleanup levels, and monitoring. Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. The primary objective of the actions described in this Proposed Plan is to address potential current and future health and environmental impacts associated with site-related contamination.

ENFORCEMENT

Investigations are currently underway to identify potentially responsible parties (PRPs) for the site.

SUMMARY OF SITE RISKS

Baseline Risk Assessment

In 2011, EPA prepared a baseline human health risk assessment and a screening level ecological risk assessment for the Raritan Bay Slag site to estimate risks associated with current and future effects of contaminants on human health and the environment.

A baseline risk assessment is an analysis of the potential adverse human health and ecological effects caused by releases of hazardous substances from a site in the absence of any actions or controls to mitigate such releases, under current and future land, groundwater, surface water and sediment uses. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

Human Health Risk Assessment (HHRA)

For the HHRA, site characterization data were used to estimate potential risk at the site, focusing on exposure to soil, groundwater, surface water, sediment, and fish/shellfish. Exposure pathways and receptors evaluated for the site in the HHRA are listed below.

- **Current Land Use Scenario:** Recreational users in Area 1, Areas 3 through 6, and Area 9; anglers throughout the site except Areas 3 and 4 (biota samples were collected to represent lead in sediment from all Areas except Areas 3 and 4); pedestrians throughout the site except Areas 2, 8, and 11; trespassers in Areas 2, 8, and 11; outdoor workers in Areas 3 and 4; and construction/utility workers throughout the site.
- **Future Land Use Scenario:** Recreational users in Areas 1 through 6, and Area 9; anglers throughout the site except Areas 3 and 4 (biota samples were collected to represent lead in sediment from all Areas except Areas 3 and 4); pedestrians throughout the site except Areas 8 and 11; trespassers in Areas 8 and 11; outdoor workers in Areas 3 and 4; construction/utility workers throughout the site; and residents throughout the site.

No unacceptable cancer risks were identified for current or potential future exposure scenarios. The following exposure pathways resulted in unacceptable non-cancer hazards:

Lead

- **Current/future ingestion of site soils in Area 2** (In Area 2, 42% of future recreational children exposed to the fine fraction of lead may have blood lead concentrations greater than 10 micrograms per deciliter ($\mu\text{g/dL}$). In all areas, 11% of the

current/future developing fetuses of female construction/utility workers may also have blood lead concentrations greater than 10 ug/dL) from exposure to lead in soil.

Ecological Risk Assessments (ERA)

A Screening Level Ecological Risk Assessment (SLERA) and an ERA prepared by EPA/Environmental Response Team (ERT) (EPA/ERT 2010) evaluated the potential risks to ecological receptors from exposure to site chemicals. The SLERA evaluated Areas 8 and 9. EPA/ERT's risk assessment evaluated Area 1. A technical addendum to the SLERA was prepared to further evaluate potential risks to ecological receptors from exposure to site chemicals at Areas 1, 8, and 9 using less conservative assumptions. The results of the SLERA indicate that lead, arsenic, copper, iron, manganese, vanadium, and zinc in surface water, and lead in soil and sediment as the only risk drivers to aquatic receptors utilizing Areas 1 and 8 and terrestrial receptors utilizing Area 9 upland areas of the site.

REMEDIAL ACTION OBJECTIVES

The following remedial action objectives (RAOs) address the human health risks and environmental concerns at the Raritan Bay Slag Site. The RAOs are organized into the following categories: principal threat waste, slag and battery casings/associated wastes, soil, and sediment.

Principal Threat Waste:

Material that meets the definition of principal threat waste exists at the site and could pose potential unacceptable risks if appropriate remedial actions are not implemented.

- Remove or treat material that meets the definition of principal threat waste, to the extent practical, and
- Prevent current or potential future migration of material that meets the definition of principal threat waste from the site that would result in direct contact or inhalation exposure, to the extent practicable.

Principal threat wastes at the site include: (1) slag and battery casings/associated wastes, including particles of slag and battery casings/associated wastes identified in the soil and sediment media; (2) highly impacted soil in the Seawall Sector in portions of Areas 1 and 2, in the Jetty Sector in Area 8 and in the upland portion of the Margaret's Creek Sector; and (3) highly impacted sediment located in Area 8 in the Jetty Sector and Areas 1 and 2 in the Seawall Sector. The RAOs for each of these principal threat wastes are listed below.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and noncancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one in ten thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6} , corresponding to a one in ten thousand to a one in a million excess cancer risk. For noncancer health effects, a "hazard index" (HI) is calculated. The key concept for a noncancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which noncancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at the site.

Slag and Battery Casings/Associated Wastes

The slag and battery casings/associated wastes contain high concentrations of lead which pose unacceptable human health and ecological risks, and act as a source of

contamination for soil, sediment, groundwater, and surface water. The RAOs for the slag and battery casings/associated wastes are listed below.

- Reduce exposure resulting from incidental ingestion of slag and battery casings/associated wastes to levels that are protective of human health.
- Reduce exposure resulting from the ingestion of slag and battery casings/associated wastes to levels that are protective of ecological receptors.
- Reduce migration of contamination from the slag and battery casings/associated wastes to surface water, soil, and sediments to levels that are protective of human health and ecological receptors.

Soil

Soil in all Areas have been impacted by the slag and battery casings/associated wastes. Some of the areas contain slag particles with high concentrations of heavy metals. The contaminated soil poses risks to human health and ecological receptors and also serves as a secondary source for sediment, surface water, and groundwater contamination. The RAOs for the contaminated soil are listed below.

- Reduce exposure resulting from inhalation (from dust) and incidental ingestion of contaminated soil to levels protective of human health.
- Reduce exposure resulting from the ingestion of contaminated soil and ingestion of contaminants via food chain to levels protective of ecological receptors.
- Reduce migration of contamination from the soil to surface water, and sediments to levels that are protective of human health and ecological receptors in Area 9.

Sediment

Lead contamination in the sediment was identified in various areas in the Raritan Bay, in particular, areas near the seawall, western jetty, and Area 2. The contaminated sediment poses risks to the ecological receptors and also serves as a secondary source for the surface water contamination. The RAOs for the contaminated sediment are listed below.

- Reduce exposure resulting from the ingestion of contaminated sediments and ingestion of contaminants via food chain to levels protective of ecological receptors.
- Reduce the migration of contamination from the sediments to surface water, and soil to levels that are protective of human health and ecological receptors.

Surface Water

WHAT IS A "PRINCIPAL THREAT"?

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund Site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, Non-Aqueous Phase Liquids (NAPLs) in ground water may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. The decision to treat these wastes is made on a site-specific basis through a detailed analysis of the alternatives using the nine remedy selection criteria. This analysis provides a basis for making a statutory finding that the remedy employs treatment as a principal element.

Based on the RI results, surface water is contaminated with lead and other heavy metals from leaching of slag and battery casings/associated wastes, contaminated soil and sediment. Although surface water is not a source, the contamination poses risks to the ecological receptors. The RAO for surface water is listed below.

- Reduce metals concentrations to levels that are protective of ecological receptors by remediating source materials.

Remediation Cleanup Levels

To meet the RAOs defined above, EPA has identified remediation cleanup levels to aid in defining the extent of contaminated media requiring remedial action. In general, remediation cleanup levels establish media-specific concentrations of site contaminants that will pose no unacceptable risk to human health and the environment. Remediation cleanup levels have also been developed to establish criteria to define the source areas deemed principal threats for the site, areas for which EPA has concluded treatment should be considered as part of the remedy.

Remediation of Slag, Battery Casing/Associated Wastes

Slag, battery casing/associated wastes will be remediated based on visual observation (i.e., waste materials observed on-site during remedial action will be removed or remediated). Slag materials that are not readily visible will be remediated as soil/sediment.

Remediation of Surface Water

The approach to remediating the surface water contamination at the site is to remove the principal threat wastes that act as sources of contamination to the surface water. This will reduce the surface water contamination

over time to acceptable levels. Monitoring will be implemented to assess the effectiveness of the approach by comparing the monitoring results to a set of remedial goals presented in Table 1. Monitoring requirements for surface water will be developed during the design phase.

Remediation Cleanup Levels for Soil and Sediment

For soil and sediment media, a two-step process was used to develop the Preliminary Remediation Goal (PRG). In the first step, a PRG was derived based on parameters specific to each media. In the second step, the soil PRG and the sediment PRG was compared and a single PRG (the unified PRG) was proposed which aimed to collectively address the entire site as a whole regardless of environmental media (e.g., soil and sediment). A single unified PRG as shown in Table 1 was proposed due to the nature of the site (comingling/relationship between soil and sediment in the intertidal zone areas). There is significant potential for re-contaminating soil or sediment if the two media were remediated to different cleanup levels. Therefore, one unified remediation cleanup level is provided for soil/sediment.

As previous noted, once the decision to take action was made and the discussion on PRGs was started, it was determined that since the unified PRG approach was most appropriate for this site, using a background concentration for wetland sediments from an area not tidally connected to the site was determined not to be appropriate. Therefore, only the soil and sediment data collected from Area 10 was used in the background evaluation for the purposes of PRG selection. Sediments collected from Whaler's Creek were only used for ecological risk purposes.

For lead, a unified remediation cleanup level of 400 milligrams per kilogram (mg/kg) was selected. This value represents the human health risk-based number which is also protective of aquatic ecological receptors based on site-specific data.

SUMMARY OF REMEDIAL ALTERNATIVES

Common Elements

Many of these alternatives include common components. Because most of the remedial alternatives will result in some contaminants remaining on the site above levels that would allow for unrestricted use (except Alternative 2), a review of these remedies will be conducted every five years, at minimum.

While exposure to surface water or groundwater did not pose any unacceptable human health risks, long-term monitoring is proposed to assess impacts from remedial

activities and to ensure that surface water concentrations decrease below acceptable levels once source materials are removed. Groundwater will be monitored solely to assess impacts from remedial activities. Monitoring requirements for groundwater and surface water will be developed during the design phase.

The disposal requirements for all alternatives would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail Toxicity Characteristic Leaching Procedure (TCLP) criteria would require treatment to meet the Land Disposal Restriction (LDR) Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. Certified clean material/fill/sands would be placed as appropriate at the excavated areas.

Dewatering would be applicable to all alternatives except the No Action alternative that involve removal of sediment and excavation of beach sand below the groundwater.

Long-term monitoring (LTM) and maintenance (except Alternative 2) would include periodic sampling and analysis of surface water, groundwater, soil, sediment, toxicity studies and/or caged bivalve studies at site locations. For alternatives that include installation of engineered containment structure(s) or installation of a cap, additional monitoring of sediment and maintenance of containment cells and caps would be performed to assess effectiveness or track progress. Details of LTM would be determined during the design phase.

In addition, institutional controls (ICs) such as a deed notice or restrictive covenant would be required for portions of the site as one component of maintaining the long-term protectiveness of all alternatives with the exception of Alternative 2. The FS addresses the objectives of ICs in more detail which are not limited to: (1) prevent exposure to contaminant concentrations, (2) control future development that could result in increased risk of exposure, and (3) restrict installation of drinking water wells within the contaminated area. Once a remedy is selected, a detailed ICs implementation strategy can be identified and refined in the design. This will entail reviewing current existing bay-wide advisories and evaluating against the selected remediation cleanup levels with input from stakeholders. Entities responsible to carry out the ICs and ensure that they are functioning as intended will be identified in the design.

All the alternatives, with the exception of the no further action alternative, include excavation/dredging of slag, battery casings/associated wastes, some volume of offsite disposal of contaminated soil and sediment and monitoring (see Figures 3 through 6).

A total of five alternatives were carried through the

screening process presented in the Comprehensive Site-wide FS. Please refer to Section 3, Development of Remedial Action Alternatives, and Section 4, Detailed Analysis of Alternatives, of the FS for a more detailed discussion of all the remedial alternatives.

Alternative 1 - No Action

<i>Capital Cost:</i>	\$0
<i>Total O&M Costs:</i>	\$0
<i>Total Present Worth:</i>	\$0
<i>Implementation Timeframe:</i>	Not Applicable

The NCP requires that a “No Action” alternative be developed as a baseline for comparing other remedial alternatives. Under this alternative, no action would be implemented to restore the contaminated soil or sediment or to remove the source materials. Contamination would continue to migrate from the slag to other media such as sediment and soil, and subsequently to surface water and groundwater. Alternative 1 does not include institutional controls.

Alternative 2 – Excavation/Dredging, Off-site Disposal, and Monitoring

<i>Capital Cost:</i>	\$78,200,000
<i>Total O&M Costs:</i>	\$500,000
<i>Total Present Worth:</i>	\$78,700,000
<i>Implementation Timeframe</i>	2 Years

Under this alternative, slag, battery casing/associated wastes, contaminated soils and sediment above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the Land Disposal Restriction Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. Contaminated wastes that pass TCLP can be disposed in a Subtitle D landfill without treatment. Certified clean material/fill/sands would be placed as appropriate at the excavated areas. Margaret’s Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret’s Creek upland areas. Figure 3 presents the conceptual design for Alternative 2.

Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Off-site Disposal of Soil and Sediment, Institutional Controls and Long-Term Monitoring

<i>Capital Cost:</i>	\$69,000,000
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<i>Total O&M Costs:</i>	\$4,000,000
<i>Total Present Worth:</i>	\$73,000,000
<i>Implementation Timeframe</i>	2 Years

Under this alternative, the slag and battery casing/associated wastes would be placed in on-site containment cells consisting of bottom liners, collection systems, lined containment walls or berms, and a low permeability cover. These cells would be constructed within the site in the upland area of Margaret’s Creek and in the asphalt area near the western jetty. There would be a wetland transition zone between the containment cell and the wetland at the Margaret’s Creek upland area. Treatment of slag to meet land disposal requirements prior to placement in the containment cell would not be required, as this operation is consolidation of waste materials within an Area of Contamination, which exempts waste consolidation from meeting LDR requirements. All contaminated soil and sediment above the remediation cleanup levels would be disposed of at appropriate off-site facilities as discussed under Alternative 2. Similar to Alternative 2, Margaret’s Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret’s Creek upland areas. Figure 4 presents the conceptual design for Alternative 3.

Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring

<i>Capital Cost:</i>	\$44,200,000
<i>Total O&M Costs:</i>	\$5,600,000
<i>Total Present Worth:</i>	\$49,800,000
<i>Implementation Timeframe</i>	2 Years

Under this alternative, a selected remediation target area in Area 8 would be capped. This alternative would also include on-site containment of slag, battery casings/associated wastes, and contaminated soil and sediment above the remediation cleanup levels excavated or dredged from other site areas. The contaminated materials from the Jetty Sector would be placed in a containment cell constructed within the Jetty Sector and the contaminated materials from the Seawall and Margaret’s Creek Sectors would be placed in a containment cell constructed within the Margaret’s Creek Sector upland area. However, the on-site containment cell in the Jetty Sector would not have the capacity to contain all the contaminated soil and sediment from the Jetty Sector. Therefore, the excavated soil and dredged sediment that could not be accommodated in the containment cells would be disposed of at appropriate off-site facilities similar to Alternative 2. For the containment cell in the Margaret’s Creek Sector, there would be a wetland transition zone between the containment

cell and the nearby wetland areas. Similar to Alternative 2, Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas. Figure 5 presents the conceptual design for Alternative 4.

Alternative 5 - Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring

<i>Capital Cost:</i>	<i>\$47,900,000</i>
<i>Total O&M Costs:</i>	<i>\$4,500,000</i>
<i>Total Present Worth:</i>	<i>\$52,400,000</i>
<i>Implementation Timeframe</i>	<i>2 Years</i>

This alternative would be similar to Alternative 4 except capping of Area 8 would not be implemented. Instead, the contaminated sediment from Area 8 would be dredged and disposed of at appropriate off-site facilities. Figure 6 presents the conceptual design for Alternative 5.

Tables 2 and 3 summarize the volumes of slag, battery casings/associated wastes, contaminated soil and sediment addressed by alternatives.

EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy, (see table below, Evaluation Criteria for Superfund Remedial Alternatives). This section of the Proposed Plan describes the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A Detailed Analysis of Alternatives can be found in the FS Report.

1. Overall Protection of Human Health & the Environment

Alternative 1 would not protect human health and the environment. Alternatives 2 through 5 would provide protection to human health and the environment. However, during dredging operations under Alternatives 2 through 5, risks to ecological receptors would temporarily increase due to the disruption caused to the aquatic habitat from the dredging operation. For Alternative 2, human health risk would be eliminated or greatly reduced through removal of contaminated materials. For Alternatives 3 through 5, human health risk would be eliminated or greatly reduced through removal and containment of contaminated materials; however, long-term maintenance of the containment cells would be required for these alternatives.

The contaminated land would be restored to beneficial use

with Alternatives 2 through 5.

Alternative 1 would not meet the RAOs. Alternatives 2 would meet the RAOs. Alternatives 3 through 5 would meet the RAOs provided that on-site containment is properly maintained.

2. Compliance with ARARs

Alternative 1 would not comply with chemical-specific applicable or relevant and appropriate requirements (ARARs) because no action would be taken. Alternative 2 would comply with chemical-specific ARARs through removal and off-site disposal. Alternatives 3 through 5 would comply with chemical-specific ARARs through various remedial activities. Action-specific and location-specific ARARs are not applicable to Alternative 1 since no action would be taken. Alternatives 2 through 5 would comply with action-specific ARARs by implementing health and safety measures during the remedial action, and by meeting regulatory requirements necessary for remedy implementation. Alternatives 2 through 5 would also comply with location-specific ARARs by meeting wetland, coastal zone, and siting requirements. Coastal restoration would be required for Alternatives 2 through 5.

3. Long-Term Effectiveness and Permanence

Alternative 1 would not be considered a permanent remedy and does not achieve long-term effectiveness since no action would be taken. Alternative 2 would remove the contaminated materials from the current unprotected locations and would achieve long-term effectiveness and permanence. Alternatives 3 through 5 would achieve long-term effectiveness through a combination of removal, off-site disposal, on-site containment and capping and would be permanent if long-term site controls are maintained.

4. Reduction in Mobility, Toxicity or Volume through Treatment

Alternative 1 would not reduce Toxicity/Mobility/Volume (T/M/V) through treatment since no treatment would be implemented. Alternatives 3 through 5 would not reduce T/V through treatment on-site; however, off-site disposal, on-site containment, and capping under Alternatives 3 through 5 would reduce the mobility of the contaminants. The use of reactive capping technologies for Alternative 4 would further reduce contaminant mobility. The toxicity of site-related metals in contaminated materials would be

reduced if treatment is conducted at the off-site disposal facility.

5. Short-Term Effectiveness

Alternative 1 would not have any short-term impact since no action would be taken. Alternatives 2 through 5 would have impacts to the community during pre-design investigations, source removal, soil excavation, sediment dredging, material handling, on-site containment, capping, and transportation and disposal operations. Alternative 2 would have larger impact on the community since it would involve major construction operations on-site, and heavy traffic on local roads during the transportation and disposal of contaminated materials off-site. Alternatives 3 through 5 would not cause as much traffic on local roads as the volume of materials disposed of off-site is lower in these alternatives. However, the on-site construction activities under Alternatives 3 through 5 would be greater due to the construction of containment cells. Due to re-suspension of sediment during dredging operations, significant adverse impact to the aquatic habitat would be expected to occur temporarily in Alternatives 2 through 5. To the extent practicable, areas designated for dredging would be dewatered prior to operations to avoid re-suspension.

6. Implementability

Alternative 1 would be the easiest to implement since it involves no action. Alternatives 2 through 5 would be technically implementable and would use conventional construction equipment, although there would be several technical challenges related to dredging and dewatering the sediment, segregating the slag, accessing work areas, siting of on-site containment cells, capping under water, and transportation logistics. Alternatives 2 through 5 would also encounter some technical challenges with regards to coastal restoration. Additionally, Alternatives 3 through 5 also could face potential issues due to settlement of the ground following placement of contaminated material in the containment cells. Alternative 2 would be the easiest to implement among the action alternatives, as it would not involve the construction and long-term maintenance of the containment cells. Alternatives 3, 4 and 5 would be more difficult to implement, as they would involve construction and long-term maintenance of the containment cells. Alternative 4 would additionally involve maintenance and monitoring of the in-situ cap.

7. Costs

Alternative 1 would not involve any costs. Alternative 2 would have the highest capital cost due to transportation and

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that are legally applicable, or relevant and appropriate to the site, or whether a waiver is justified.

Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

disposal of the contaminated materials. Alternative 4 would have the lowest cost because of the use of capping. Table 4-3 in the FS summarizes the capital, operations and maintenance, and present worth costs for each alternative.

8. State/Support Agency Acceptance

The State of New Jersey concurs with EPA's preferred alternative as presented in this Proposed Plan.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Record of Decision, the document that formalizes the selection of the remedy for the site.

PREFERRED ALTERNATIVE

EPA has identified Alternative 2 as the preferred alternative. This alternative provides for the removal of all Principal Threat Waste (PTW), soil and sediment above the remediation cleanup level (see Table 1). Under this alternative, slag, battery casing/associated wastes (approximately 11,100 cubic yards), and contaminated soils and sediment (approximately 81,000 cubic yards) above the cleanup level would be excavated and/or dredged and disposed of at appropriate off-site facilities. The disposal requirements would depend on the metal concentrations and results of required regulatory tests on the wastes. Contaminated wastes that fail TCLP would require treatment to meet the LDR Treatment Standards for contaminated soil prior to disposal in a Subtitle C landfill. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate at the excavated areas in the Margaret's Creek upland areas.

The Preferred Alternative at an estimated cost of \$78.7 Million is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. The Preferred Alternative will not result in contaminants remaining on the site above levels that would require restricted use. In addition, a review of the remedy will not be required every five years and the Preferred Alternative will not require long-term monitoring. The removal of all PTW is preferred to those alternatives with on-site containment located in a recreational area and residential community. As the leaching tests conducted as part of the RI indicate, the slag and battery casings exhibit the potential for leaching. EPA believes that the Preferred Alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent

practicable. The preferred alternative can change in response to public comment or new information.

It should also be noted that the Preferred Alternative was reviewed by the National Remedy Review Board. The Board, which includes program experts across EPA, evaluates proposed high-cost remedies for cost effectiveness and national consistency. The Board comments and Regional response are included in the administrative record for the site.

COMMUNITY PARTICIPATION

EPA encourages the public to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted there.

The dates for the public comment period, the date, location and time of the public meeting, and the locations of the Administrative Record files, are provided on the front page of this Proposed Plan. Written comments on the Proposed Plan should be addressed to the Remedial Project Manager or Community Involvement Coordinator listed below.

EPA Region 2 has designated a Regional Public Liaison as a point-of-contact for the community concerns and questions about the federal Superfund program in New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands. To support this effort, the Agency has established a 24-hour, toll-free number that the public can call to request information, express their concerns, or register complaints about Superfund. This information is provided below.

For further information on the Raritan Bay Slag Superfund Site, please contact:

Tanya Mitchell Remedial Project Manager (212) 637-4362 mitchell.tanya@epa.gov	Pat Seppi Community Involvement Coordinator (212) 637-3679 seppi.pat@epa.gov
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Written comments on this Proposed Plan should be mailed to Ms. Mitchell at the address below or sent via email.

U.S. EPA

290 Broadway, 19th Floor
New York, New York 10007-1866

The public liaison for EPA's Region 2 is:

George H. Zachos
Regional Public Liaison
Toll-free (888) 283-7626
(732) 321-6621

U.S. EPA Region 2
2890 Woodbridge Avenue, MS-211
Edison, New Jersey 08837-3679

Table 1
Remediation Cleanup Levels
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

COCs	Slag/Battery Casing/ Associated Wastes	Contaminated Soil and Sediment (mg/kg)	Surface Water (µg/L)	Basis
Lead	Removal of source materials by visual observation	400	24	Human health risk-based value
Arsenic	NA	NA	36	ARAR based value
Copper	NA	NA	3.1	ARAR based value
Iron	NA	NA	1,000	ARAR based value
Manganese	NA	NA	120	ARAR based value
Vanadium	NA	NA	20	ARAR based value
Zinc	NA	NA	81	ARAR based value

Notes:

COCs - Contaminants of Concern

NA - Not Applicable

ARAR - Applicable or Relevant and Appropriate Requirement

mg/kg - milligrams per kilogram

µg/L - micrograms per liter

Table 2
Summary of Proposed Alternatives
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey

List of Alternatives	Description	Source Material Volume		Soil/Sediment Volume		Containment Cell Volume	Capping Volume (Area 8)
		On-Site	Off -Site	On-Site	Off-Site	On-Site	On-Site
Alternative 1	No Action						
Alternative 2	Excavation/Dredging, Offsite Disposal, and Monitoring		11,100		81,000		
Alternative 3	Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring	11,100*			81,000	11,100	
Alternative 4	Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring	11,100*		61,400*	10,400	72,500	9,200
Alternative 5	Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring	11,100*		61,400*	19,600	72,500	

Note: 1) All volumes are reported in cubic yards 2) * Volume included under onsite containment cells

Table 3
Summary of Volumes Addressed by Remedial Components of Alternatives
Feasibility Study
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, NJ

	Alternative 2				Alternative 3				Alternative 4				Alternative 5			
	Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment		Source Materials		Soil/Sediment	
	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors	Jetty Sector	Seawall and MC Sectors
Volume addressed by Off-site Disposal (CY) *	5,000	6,100	25,300	55,700	-	-	25,300	55,700	-	-	10,400	-	-	-	19,600	-
Volume addressed by On-site Containment (CY) *	-	-	-	-	5,000	6,100	-	-	5,000	6,100	5,700	55,700	5,000	6,100	5,700	55,700
Volume addressed by Capping (CY) *	-	-	-	-	-	-	-	-	-	-	9,200	-	-	-	-	-
Total Volume (CY) *	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700	5,000	6,100	25,300	55,700

Notes:

CY - Cubic Yards

MC - Margaret's Creek

Alternative 1 - No Action

Alternative 2 – Excavation/Dredging, Offsite Disposal, and Monitoring

Alternative 3 – Excavation/Dredging, On-Site Containment of Source Materials, Offsite Disposal of Soil And Sediment, Institutional Controls and Long-Term Monitoring

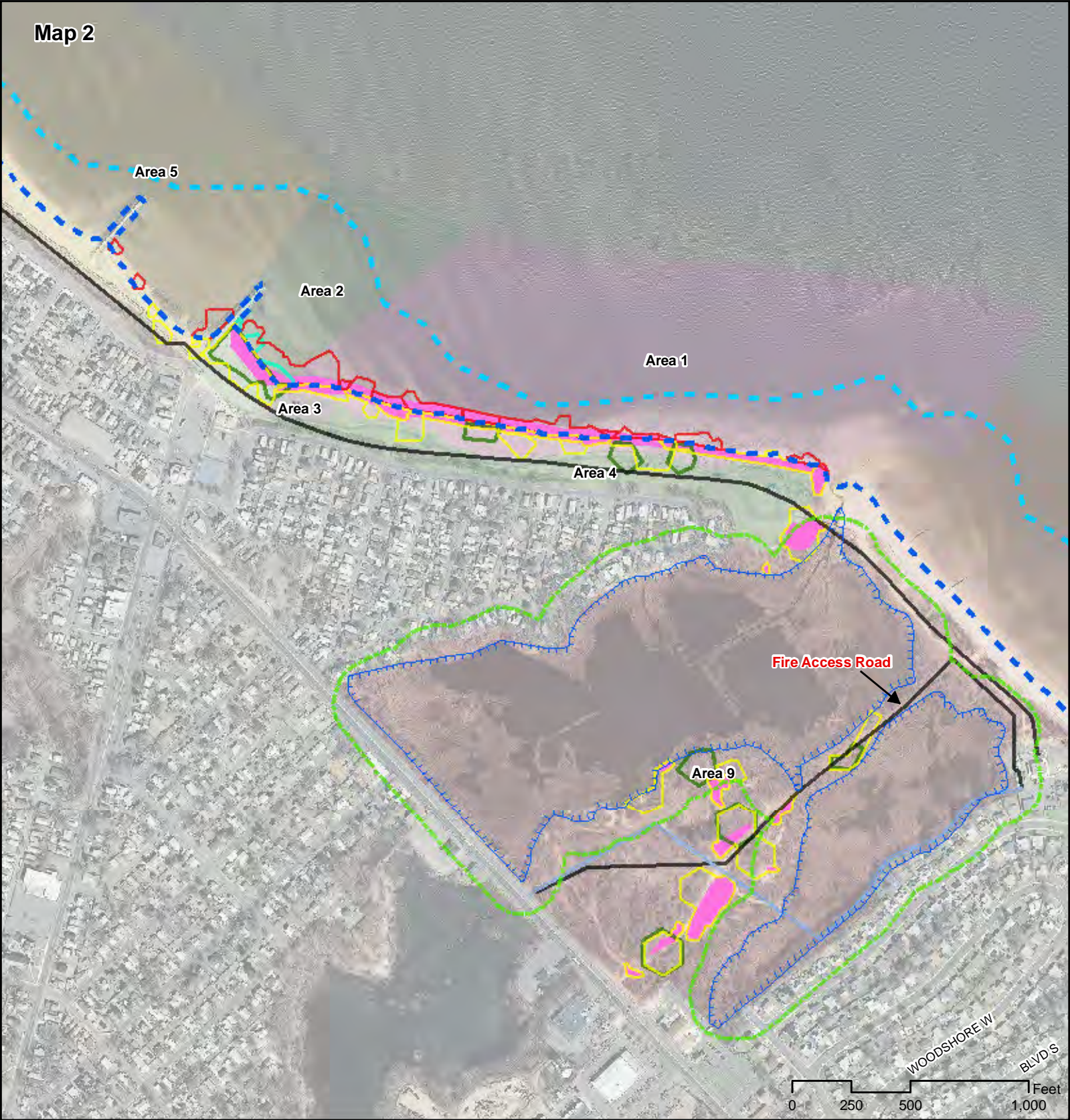
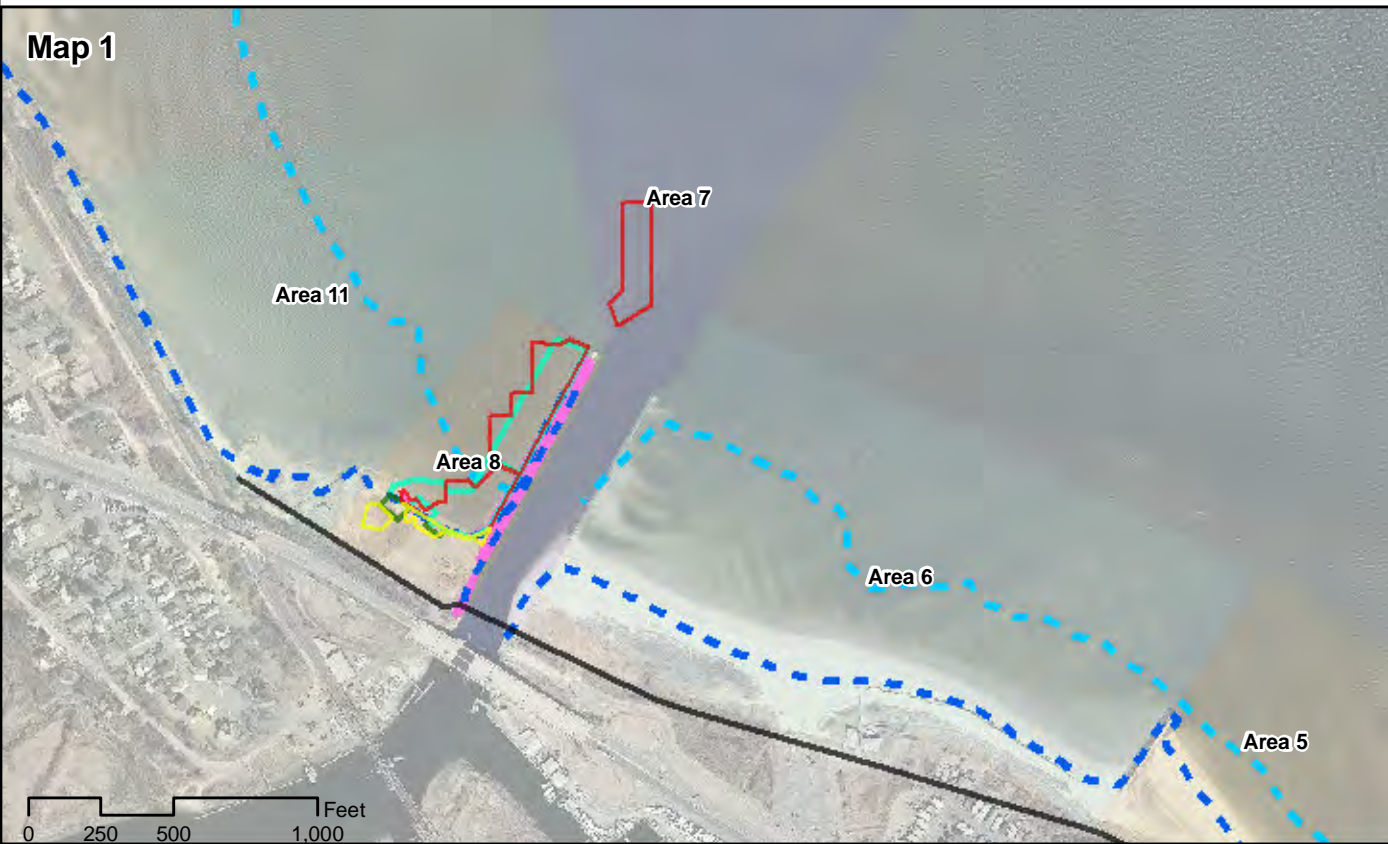
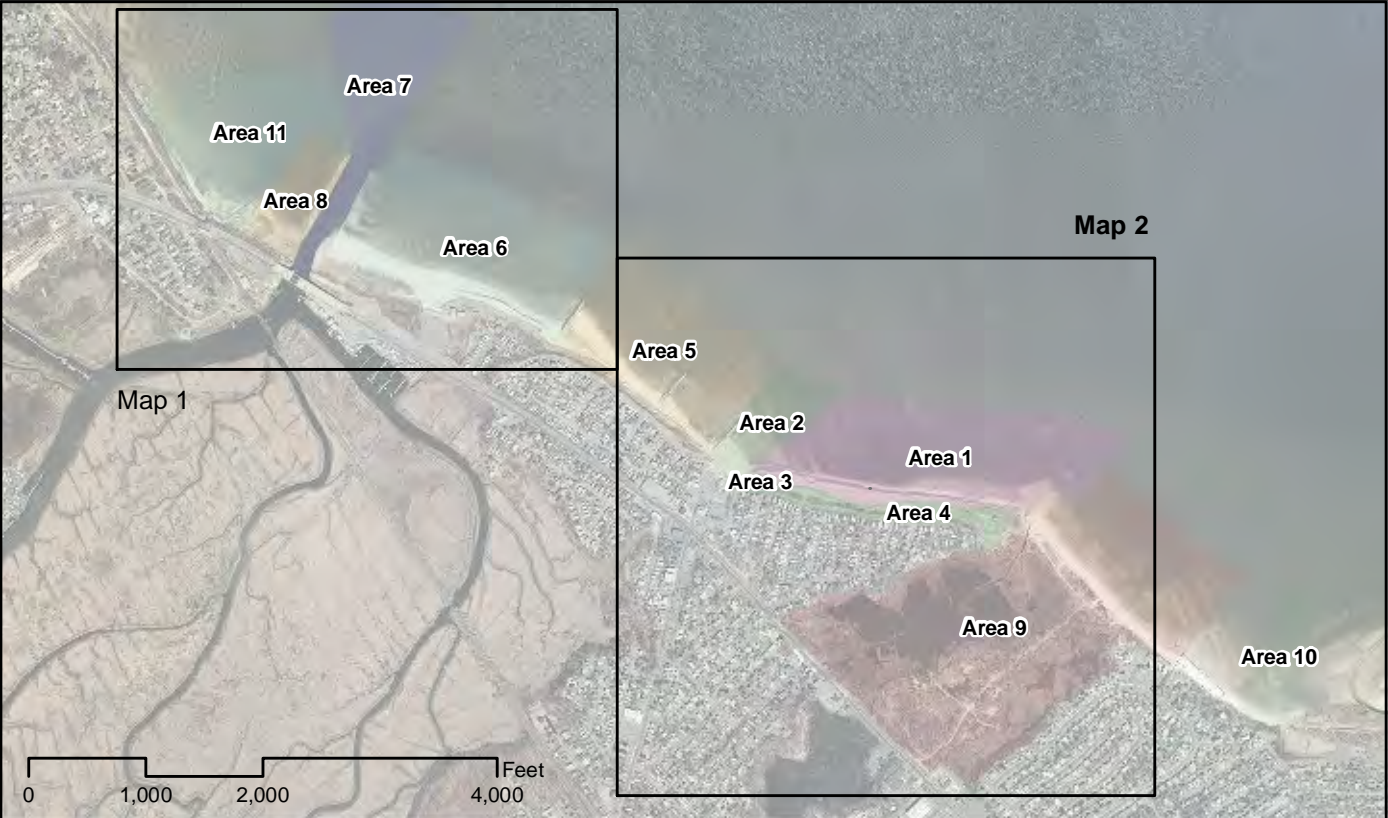
Alternative 4 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, Institutional Controls and Long-Term Monitoring

Alternative 5 – Excavation/Dredging, On-Site Containment, Off-Site Disposal, Institutional Controls and Long-Term Monitoring

* - All volumes are rounded to the nearest hundred CY



Seawall Sector	Area 1: Laurence Harbor Seawall	The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
	Area 2: Laurence Harbor Beach	The beach area at the foot of Laurence Parkway between the western end of the seawall and the first jetty.
	Area 3: Laurence Harbor Playground	The park playground adjacent to the western end of the seawall.
	Area 4: Old Bridge Waterfront Park	The park area along the seawall (not including the playground) from the fence to the roadway.
	Area 5: Laurence Harbor Beach	The beach area between the first and third jetty.
	Area 6: Laurence Harbor Beach	The beach area between the third jetty and Cheesapeake Creek Inlet eastern jetty.
Jetty Sector	Area 7: Cheesapeake Creek Inlet	The inlet between the eastern and western jetties from the Route 35 Bridge into Raritan Bay to the extent of sediment deposition.
	Area 8: Cheesapeake Creek Inlet Western Jetty	The jetty and adjacent subtidal area west of the inlet in Sayreville.
	Area 11: Western Extent	The extent of the site west of Area 8.
Margaret's Creek Sector	Area 9: Margaret's Creek	The wetlands and upland areas associated with the Creek (between the beach and Route 35), including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
Background Area	Area 10: Background Area	The historical background sampling location.



Legend

Surface Remediation Target Area

- Surface Soil
- Surface Sediment

Subsurface Remediation Target Area

- Subsurface Soil
- Subsurface Sediment

Soil/Sediment Demarcation Line

Existing Sewerline

Abandoned Sewerline

Mean high tide line

Spring low tide line

Wetlands and wetland transition zone (estimated)

Slag and Battery Casings/Associated Wastes

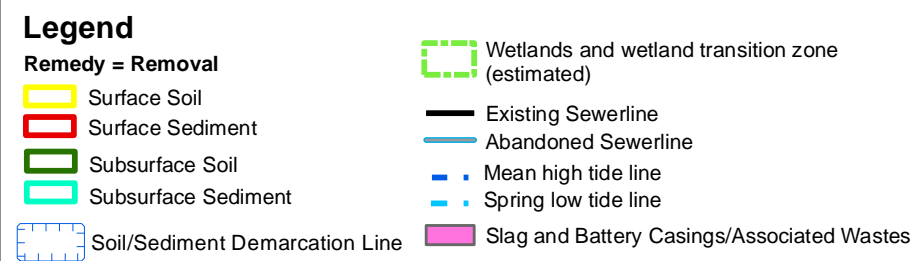
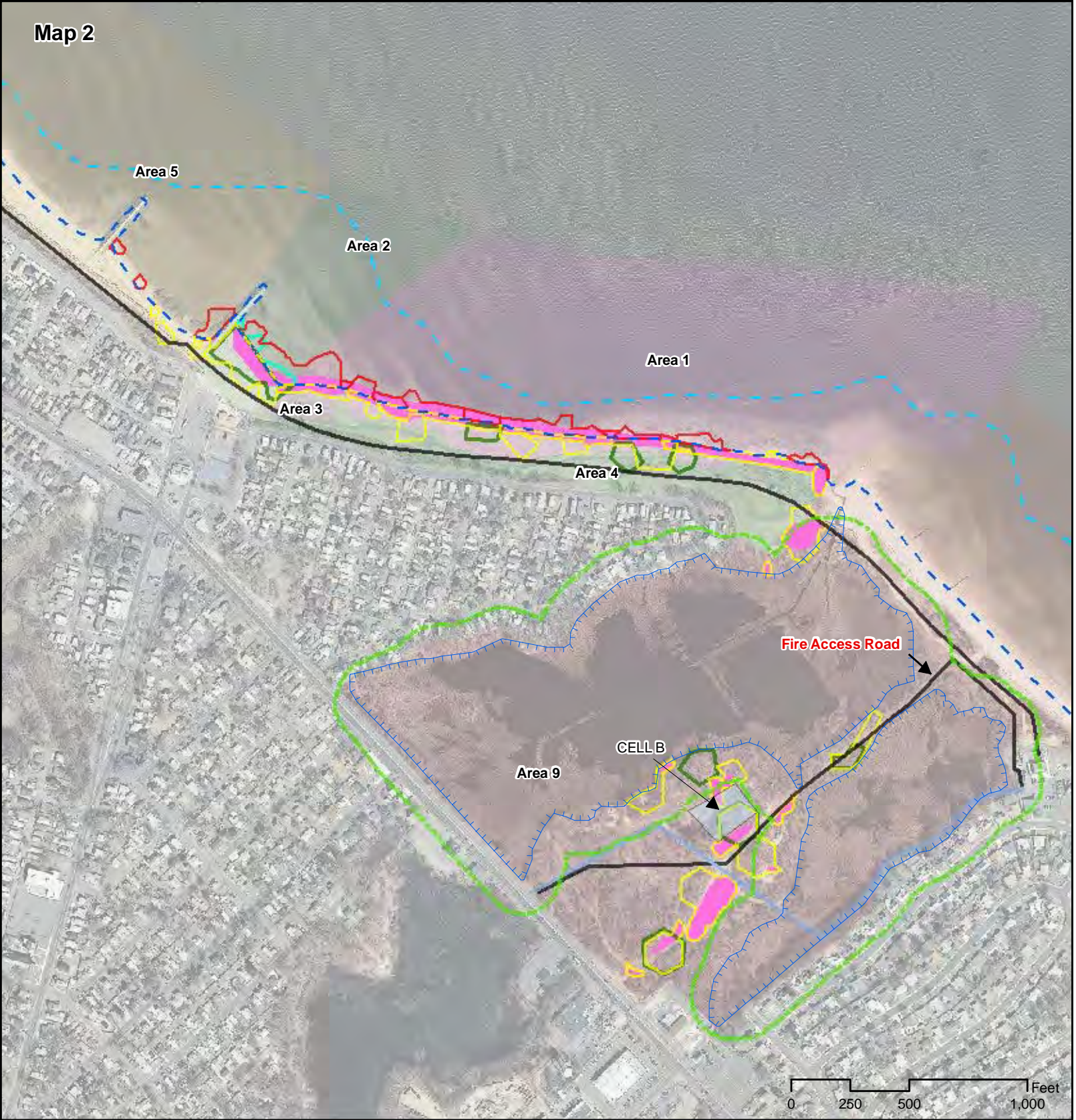
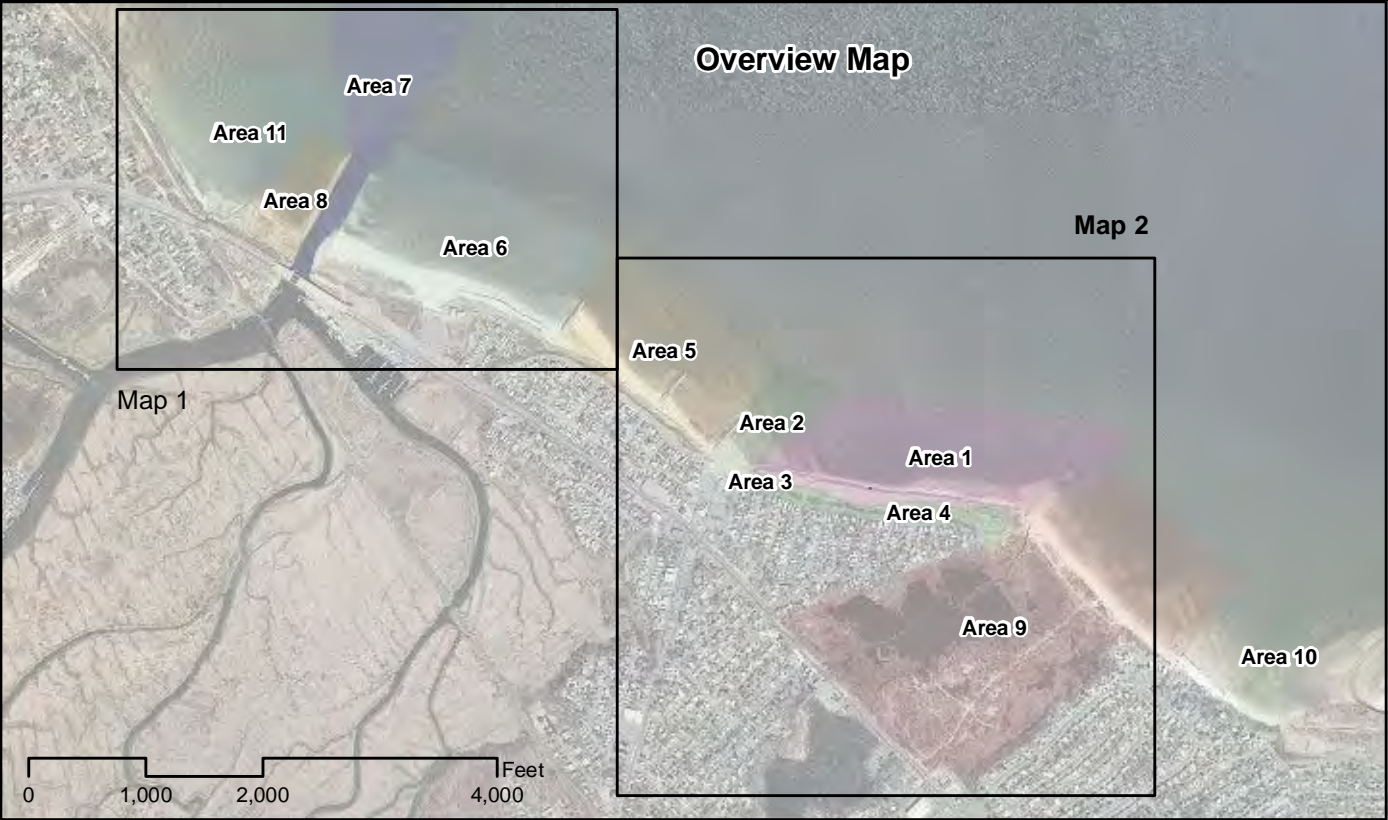
- Alternative 2 consists of removal and off-site disposal of contaminated materials, and monitoring of surface water.
- The slag and battery casings/associated wastes will be removed from the areas shown and disposed of to Subtitle C landfill.
- The contaminated soil will be excavated and disposed of to Subtitle D or Subtitle C landfill based on the TCLP test results.
- The contaminated sediment will be dredged, dewatered and disposed of to a Subtitle D or Subtitle C landfill based on the TCLP test results.
- The existing sewerline is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

Figure 3

Conceptual Design for Alternative 2 - Off-Site Disposal

Raritan Bay Slag Superfund Site

Old Bridge/Sayreville, New Jersey



1. Alternative 3 consists of the following components:
- On-site containment of source materials in containment structures or "cells"
 - Removal and off-site disposal of remaining contaminated soil and sediment
 - Long-term monitoring of the site, including the monitoring and maintenance of the containment cells and institutional control measures.
2. The slag and battery casings/associated wastes from the Jetty Sector will be removed and contained within Cell A near the western jetty and the slag and battery casings from the Seawall and Margaret's Creek Sectors will be placed within Cell B in the upland areas of the Margaret's Creek Sector at the locations shown in the figure.
3. The removal and off-site disposal of remaining contaminated soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.
4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.
5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.
6. IC measures would include deed restrictions and biennial certification regarding the maintenance of the cells.
7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

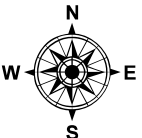
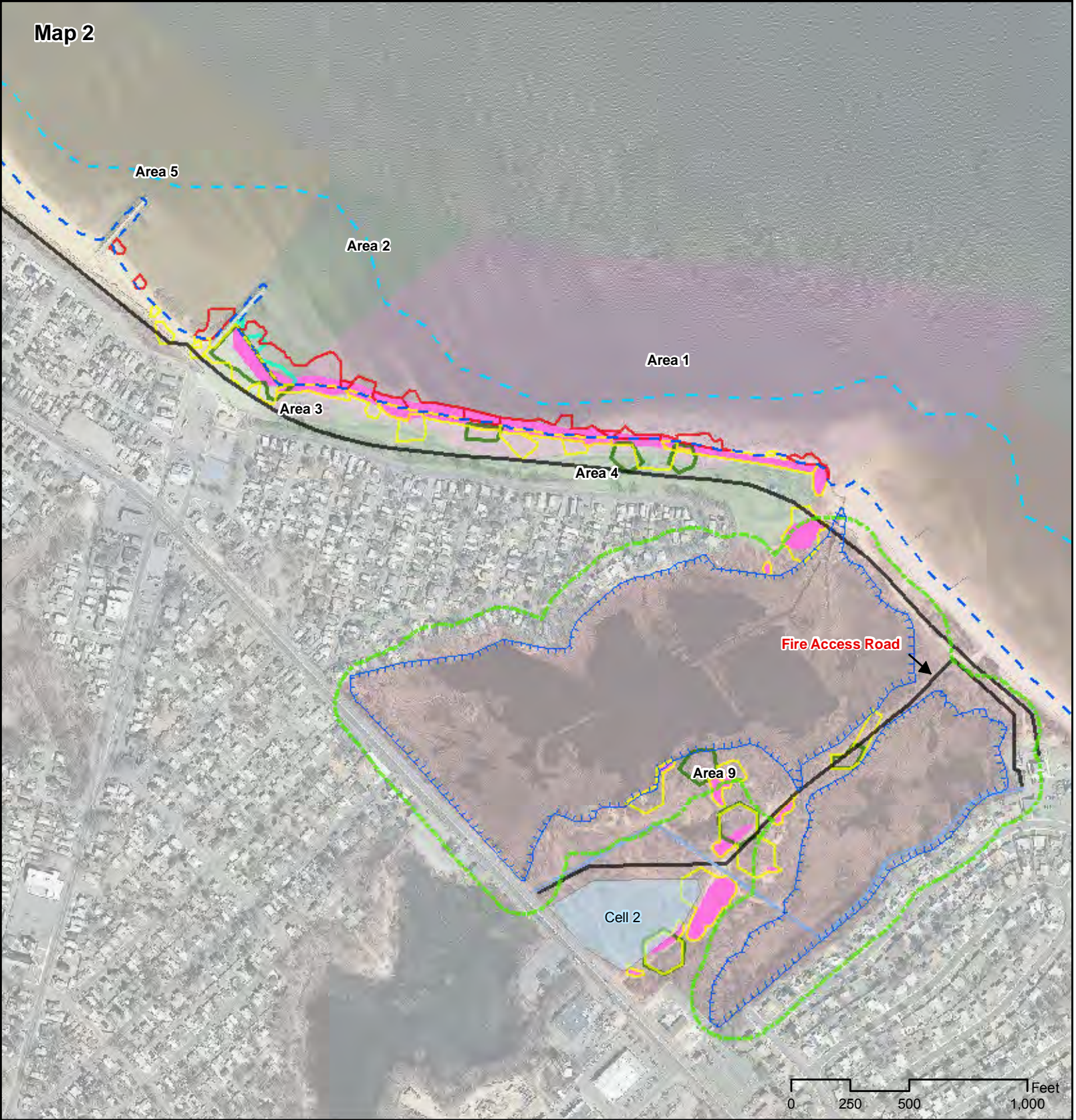
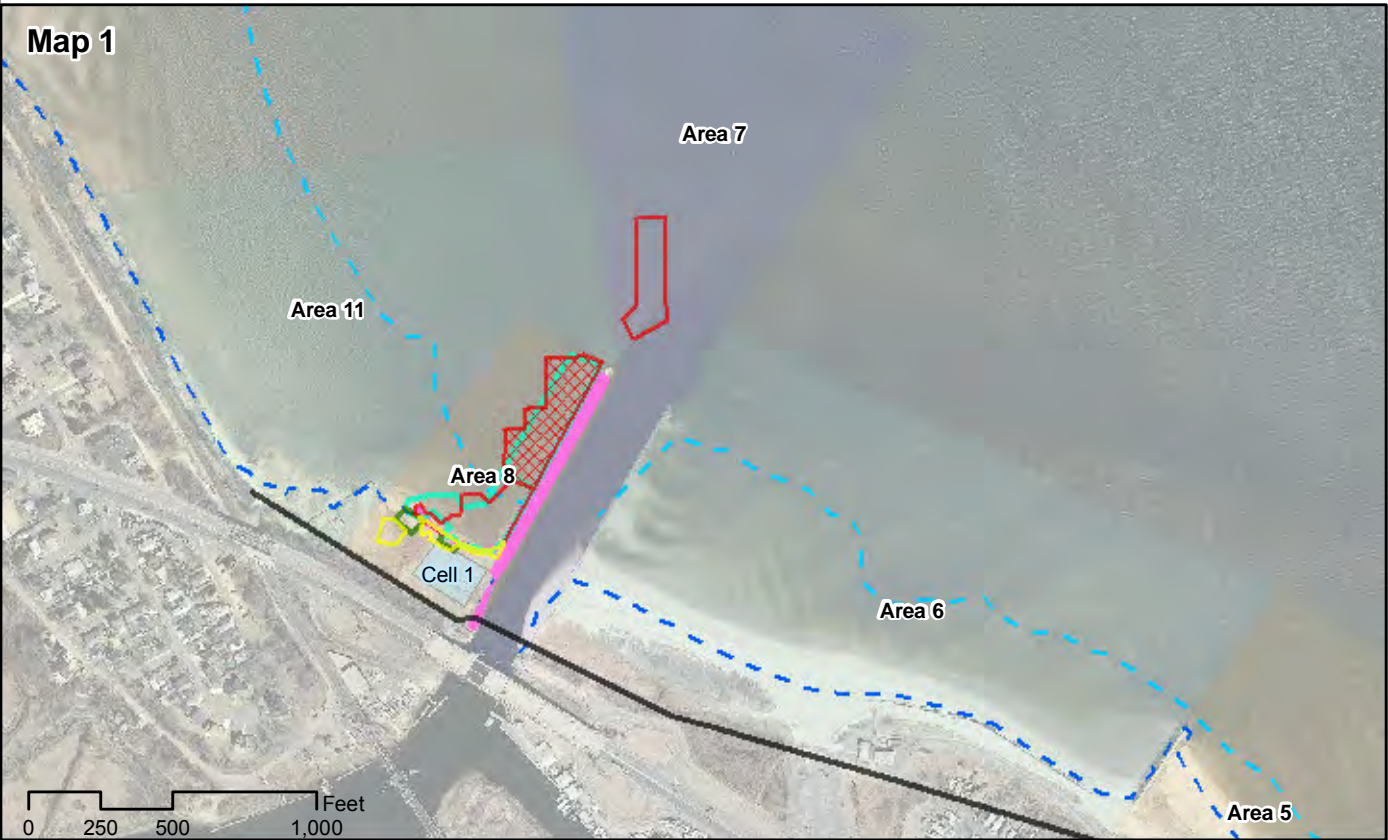
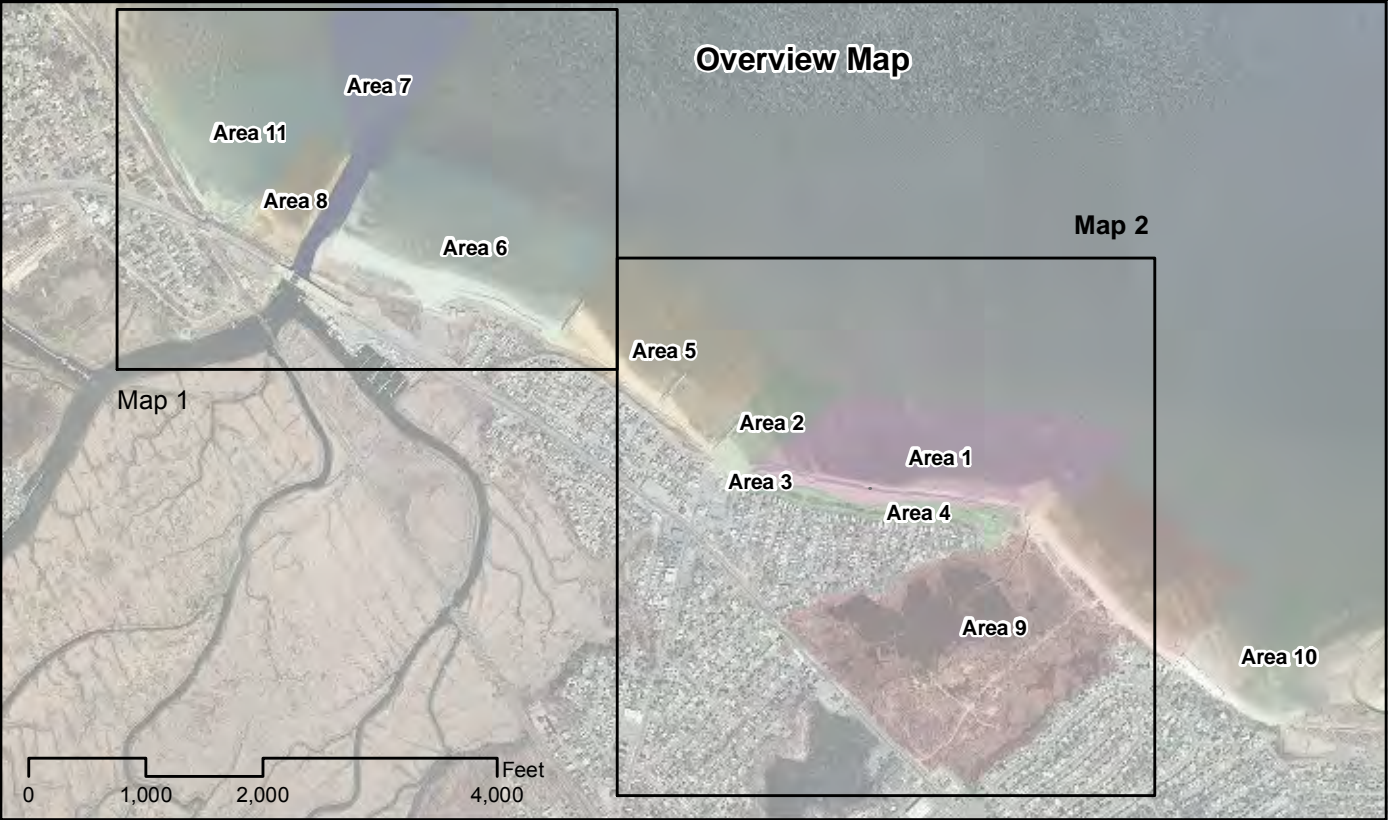
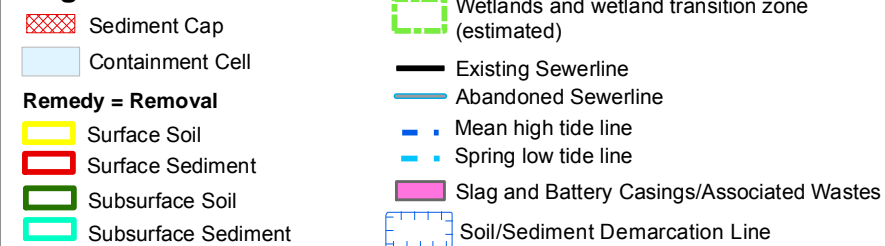


Figure 4
Conceptual Design for Alternative 3
On-Site Containment of Source Materials
and Off-site Disposal of Soil and Sediment
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey





Legend



1. Alternative 4 consists of the following components:
- i. Capping of a select area of contaminated sediments in Area 8
 - ii. On-site containment of source materials and soil and sediment in containment structures or "cells"
 - iii. Removal and off-site disposal of remaining contaminated soil and sediment
 - iv. Long-term monitoring of the site, including the monitoring and maintenance of the containment cells, cap, and institutional control measures.
2. The slag, battery casings/associated wastes, soil and sediment from the jetty sector will be removed and contained within Cell 1 near the western jetty and the slag, battery casings, soil and sediment from the seawall and Margaret's creek Sectors will be placed within Cell 2 in the Margaret's Creek upland area shown in the figure.
3. The removal and off-site disposal of remaining contaminated soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.
4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.
5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.
6. IC measures would include deed restrictions at the cell areas and biennial certification regarding the maintenance of the cells .
7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

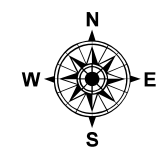
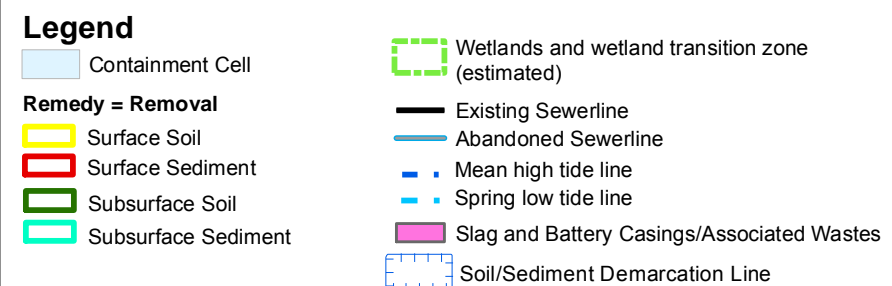
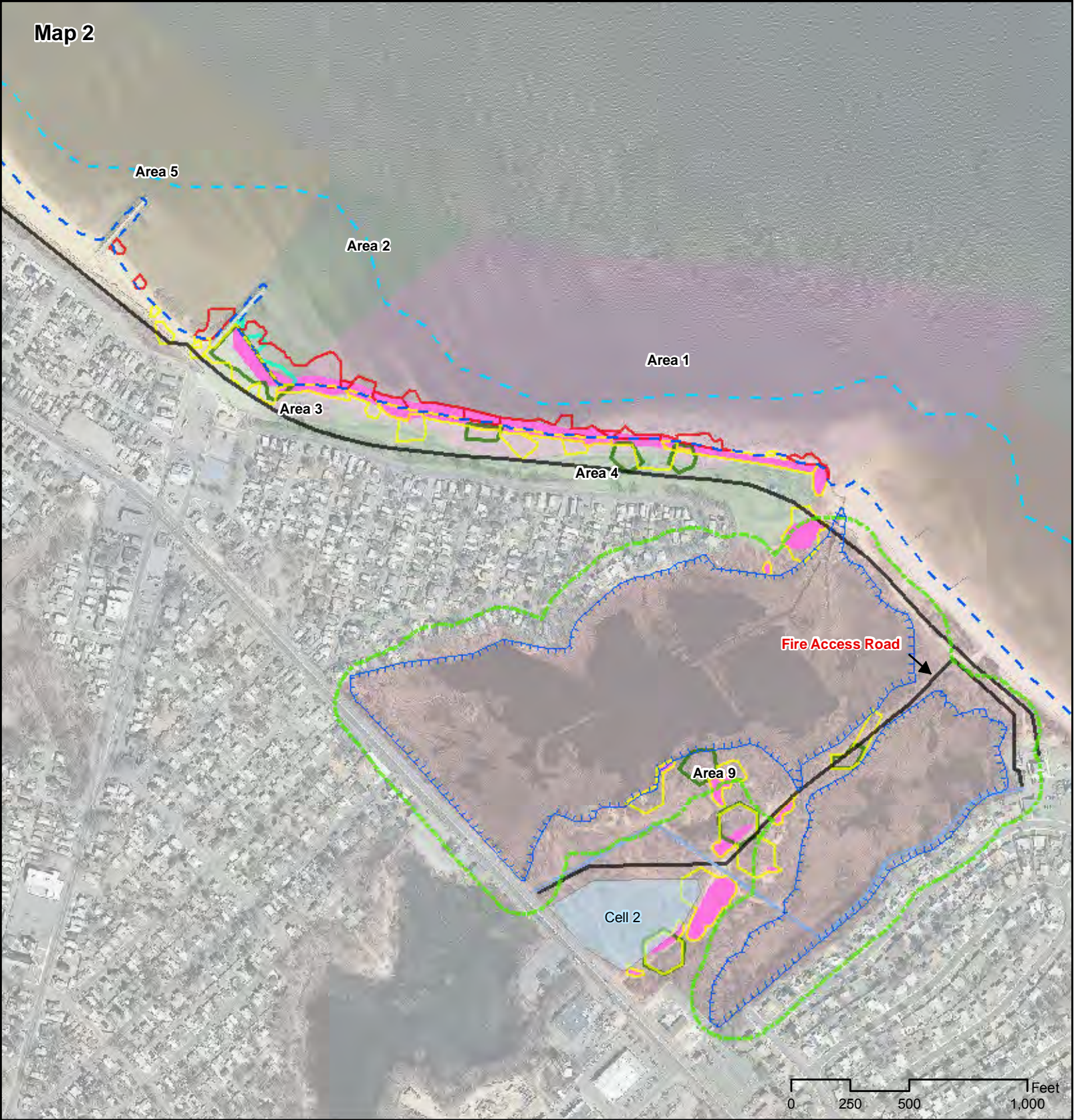
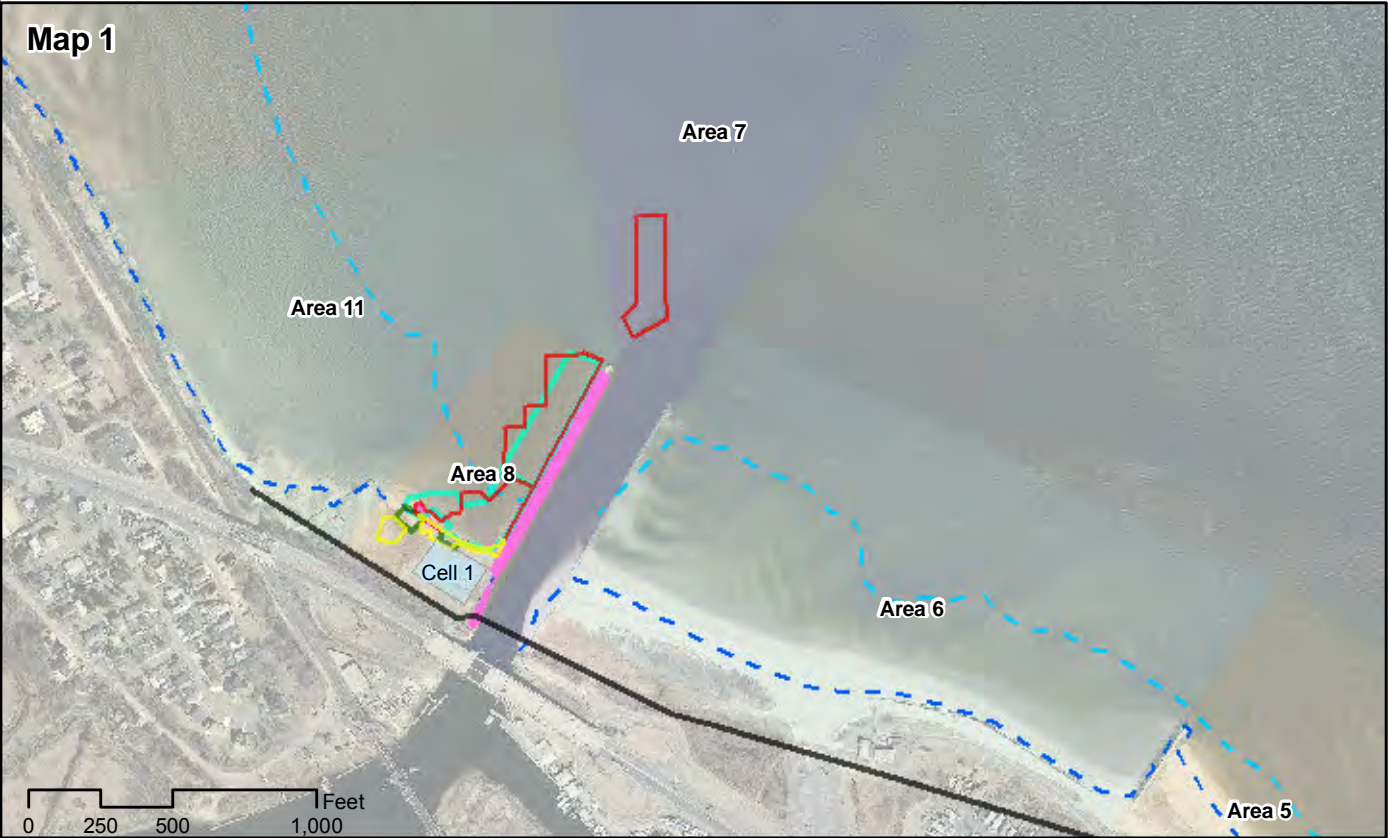
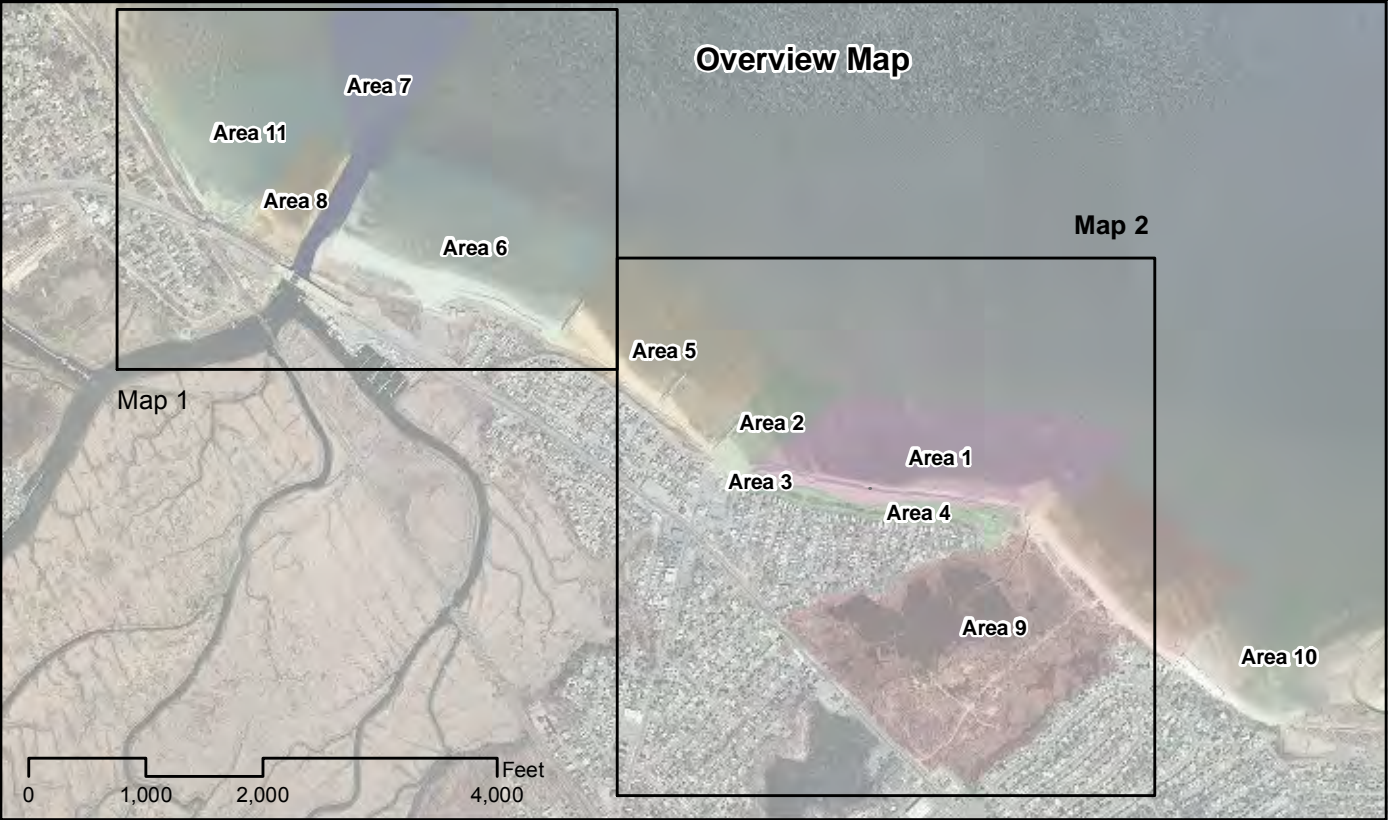


Figure 5
Conceptual Design for Alternative 4
Capping, On-Site Containment, and Off-site Disposal
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey





1. Alternative 5 consists of the following components:

- ii. On-site containment of source materials and contaminated soil and sediment in containment structures or "cells"
- ii. Removal and off-site disposal of remaining contaminated soil and sediment
- iii. Long-term monitoring of the site, including the monitoring and maintenance of the containment cells and institutional control measures.

2. The slag, battery casings/associated wastes, soil, and sediment from the jetty sector will be removed and contained within Cell 1 near the western jetty and the slag, battery casings, soil, and sediment from the seawall and Margaret's Creek Sectors will be placed within Cell 2 in the Margaret's Creek upland area shown in the figure.

3. The removal and off-site disposal of remaining soil and sediment would be conceptually similar to Alternative 2, except for the reduced volumes.

4. Both containment cells would consist of top and bottom liners made of impermeable material, a drainage layer along with pipes for leachate collection, a gas venting layer, a 2-foot layer of sandy loamy material at top with additional 6 inches topsoil in which seeding would be performed.

5. Long-term monitoring and maintenance of the cells would be performed to ensure effectiveness of containment.

6. IC measures would include deed restrictions at the cell areas and biennial certification regarding the maintenance of the cells.

7. The existing sewer line is based on Laurence Harbor Force Main Drawings, dated June 1986 and Laurence Harbor Interceptor overall site plan dated March 2007 provided by Old Bridge Municipal Utilities Authority.

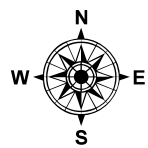


Figure 6
Conceptual Design for Alternative 5
On-Site Containment, Off-site Disposal
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey



APPENDIX D – Public Meeting Transcript

1

2 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

3 REGION 2

4 - - - - -x

5

6 RARITAN BAY SLAG SUPERFUND SITE

7 SUPERFUND PROGRAM PROPOSED PLAN

8

9 - - - - -x

10

11 George Bush Senior Center
12 1 Old Bridge Plaze
13 Old Bridge, New Jersey

14

15 October 17, 2012
16 7:15 o'clock p.m.

17

18 A P P E A R A N C E S:

19

20 PAT SEPPI,
21 Community Involvement Coordinator

22

23 MICHAEL SIVAK,
24 Section Chief

25

26 TANYA MITCHELL,
27 Remedial Project Manager

28

29 LORA SMITH,
30 Human Health Risk Assessor

31

32 MINDY PENSAK,
33 Ecological Risk Assessor

34

35 MICHAEL SCORCA,
36 Hydrogeologist

37

38 Tina DeRosa, Reporter

1 Proceedings

2 MS. SEPP: Good evening,
3 everybody. Can everybody hear me.
4 Good. We're having a few technical
5 difficulties right now and hopefully
6 we will have them straightened out and
7 we'll have our Power Point
8 presentation ready in a few minutes,
9 but, you know, we can get started.

10 And I would like to thank
11 everybody for being here tonight. The
12 reason we are here tonight is to talk
13 about EPA preferred remedy for the
14 Raritan Bay Slag Superfund Site.

15 And I know, I'm sure that
16 everybody here feels like it's been a
17 really long time, but I have to tell
18 you in all the years that I have
19 worked with the EPA, and it's a long
20 time, I have never seen a site go from
21 being put on the national priorities
22 list to being here where we are
23 tonight with a remedy.

24 And I know it's your beach and
25 I know you would like to see it open

So hopefully everybody has had

There are copies of it on the table.

see it online on our web page and

we are trying to generate a good

good snail mail list, but we don't

if everybody could put their e-mail on

list of people that I send information

A couple -- just something I

recognize before we get started is we

your local residents for the past

couple of years. They are the members

1 Proceedings

2 of the Community Advisory Group for
3 the site, and again I sound like I'm
4 pandering and I'm not, but we have a
5 lot of community advisory groups at a
6 lot of sites and I'm really, really
7 happy with the group that we have. I
8 have never worked with such a group of
9 dedicated involved people and I guess
10 it's because the site truly is in
11 their backyard and, you know, they
12 really want to see things happen and
13 cleaned up. But just to see how far
14 they have come as far as the technical
15 stuff that we deal with on the site is
16 just amazing to me.

17 So if anybody is here from the
18 Community Advisory Group I would
19 appreciate if you would stand up and
20 let your neighbors see who you are and
21 the work that you have done for such a
22 long time. They certainly deserve a
23 round of applause.

24 (Applause.)

25 MS. SEPPI: All right. Are we

1 Proceedings

2 getting close to being ready to start,
3 what do you think. Maybe.

4 Well, in the meantime what I'd
5 like to do, we have Senator Menendez'
6 aide here, Carolyn Fefferman here and
7 Congressman Pallone here in person and
8 they both have statements they would
9 like to make. So while we're trying
10 to get this technical difficulty put
11 to rest maybe you could come up and
12 give your statements now. That would
13 be fine. Congressman Pallone, yes.
14 And then I'm going to turn it over to
15 the Mayor. I know you had a few
16 remarks after Carolyn. Thank you.
17 Sorry about this.

18 CONGRESSMAN PALONE: No. O.
19 That's fine. Thank you very much. I
20 am going to stay though because I want
21 to not only hear the EPA's
22 presentation, but also from all the
23 constituents.

24 And I just wanted to say, I
25 wanted to thank everyone including the

1 Proceedings

2 EPA for being here, but particularly
3 the community leaders that worked on
4 this project and I agree with you that
5 they are a great group.

6 And I want to stress which I
7 think everybody knows that the
8 remediation of this site is incredibly
9 important to the community. It's not
10 just an abandoned industrial site in
11 the middle of nowhere. It's an
12 integral part of the local community
13 and it's used heavily by the public
14 for all kinds of recreational
15 activities. And it's essential that
16 it be cleaned up in a quick and
17 comprehensive manner.

18 As you know myself and the two
19 Senators, including Senator Menendez'
20 representative here tonight we worked
21 to have the site added to the
22 Superfund National Priority List and I
23 do believe that with the issuance of
24 the EPA's proposed cleanup plan for
25 the site we're now on the way to a

Proceedings

full cleanup so that the public can go back to using it without worrying about health hazards.

I'm also encouraged by the EPA's plan to remove contaminants from the site instead of landfilling in material. I think that's very important to all of us and I think the end result will be a clean and safe waterfront area that everyone in the community will be able to use without worry.

I just wanted to say, you know, obviously I want to hear the presentation tonight and see what others say and I'm sure that after listening to everybody there's a lot more that we need to do and things that need to be incorporated in the cleanup, so we'll see.

But I did want to mention
before I sat down that it's also
important I think in the larger sense
as some of you heard me say this

1 Proceedings

2 before that we reauthorize the
3 Superfund program. I don't like the
4 fact that many times if there isn't a
5 responsible party, and we do have a
6 responsible party as far as we know
7 here, but if there isn't a responsible
8 party that oftentimes the Superfund
9 sites now depend on your tax dollars
10 and general revenue to pay for things.

11 And actually most cleanups do
12 involve some sort of Federal dollars
13 which is your tax dollars, you know,
14 at some stage and probably this one
15 has too for all I know. But the
16 reason that that's a problem is
17 because we don't really have the
18 Superfund anymore.

19 We talk about Superfund as if
20 it exists. It doesn't. I mean the
21 sites are called Superfund sites, but
22 the actual Superfund which was a trust
23 fund that was paid into by the oil and
24 chemical industry through a tax has
25 expired and so basically you use your

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2 income tax to pay for a Superfund
3 cleanup when there's not a responsible
4 party and that's not right.

5 So one of the things I'm
6 working towards is to reinact the
7 Superfund as a trust fund paid for
8 with a tax on the oil and chemical
9 industry so that the taxpayers don't
10 have to pay. And also we have enough
11 money to do a lot of the cleanups
12 which often don't occur right now.

13 So I just wanted to mention
14 that, but again I'm really here
15 tonight to listen to what the EPA and
16 the community leaders have to say.
17 And I do think that what the EPA has
18 come up with is good, but there may be
19 other things you think need to be
20 attached to it and we'll see tonight
21 from here on in.

22 So thank you very much. Thank
23 you for all your help and the work
24 you've put into this.

25 (Applause.)

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2 MS. SEPPI: Thank you also,
3 Congressman Pallone. If I'd known you
4 were going to stay for the meeting --
5 well, then you'll be up for comments
6 again when we get to that point. I
7 appreciate it.

8 I don't know, maybe we're
9 getting closer. Just take your
10 agendas and rip them up obviously
11 we're not going by the book tonight,
12 but we'll do the very best we can.

13 So what I'd like to do now --
14 one thing I did want to mention just
15 before Carolyn comes up, is if you'll
16 notice we do have a stenographer
17 tonight. This is a public meeting
18 that we're required by law to have
19 whenever we have a proposed plan.

20 So all your comments that you
21 will give after our presentation will
22 be scripted and we'll have a
23 transcript of this meeting and those
24 will be comments that will be
25 addressed when we issue our record of

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2 decision which is like our final
3 legally binding document that sets out
4 exactly what it is that we plan to do
5 at the site.

6 So when we get to the point
7 I'm going to ask you to please come
8 up. We'll give you the microphone.
9 State your name so we will have it for
10 the record. And just quickly do a lot
11 of people have comments tonight. I
12 want to make sure we have enough time
13 for everybody. Could you just raise
14 your hand if you want to. That's
15 fine. I mean I thought if there were
16 like a hundred people who have
17 comments we will have to put a time
18 limit on it, but I don't think we'll
19 have to. So that's fine.

20 So I'd like to introduce
21 Carolyn Fefferman. She is Senator
22 Menendez' aide, he has been a
23 proponent of Superfund for a long time
24 and I think she has some remarks.

25 MS. FEFFERMAN: Good evening,

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2 everyone. It's a pleasure to be here.

3 Just before I read the
4 Senator's statement, several years ago
5 the EPA invited staff, the Senator was
6 not available, it was a weekday and he
7 was in Washington, to come see the
8 site. And we learned a lot that day.
9 And we are so glad the EPA has
10 addressed this issue so quickly. And
11 as Pat said earlier, you know, it
12 seems slow to some of you, but to
13 those of us who have been in other
14 Superfund sites it's gone really
15 quickly. So that's all good news.

16 The Senator's remarks and in
17 terms of the preferred plan so I would
18 like to read that.

19 I heartily support the
20 Environmental Protection Agency's
21 preferred alternate in the proposed
22 plan in the Raritan Bay Slag Superfund
23 Site because of the threat of exposure
24 that lead poses to the people of Old
25 Bridge, Sayreville, and Middlesex

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2 County.

3 Back in the spring of 2009
4 along with Congressman Pallone and
5 Senator Lautenberg I wrote EPA
6 Administrator Lisa Jackson to urgently
7 place this site on the national
8 priorities list and expedite the
9 investigation efforts in order to
10 protect human health in the
11 environment. With children
12 particularly at risk expediting this
13 study was the right thing to do.

14 Now, in just three years an
15 expedited remedial investigation and
16 feasibility study has taken place.
17 The results are the proposed plan, the
18 section of Alternative 2 as the
19 preferred alternative, excavation,
20 dredging, off-site disposal and
21 monitoring.

22 I applaud the EPA for its
23 quick action, for its choice of
24 Alternative and affirm my strong
25 support to continue the pace as we

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2 move forward with the removal of the
3 toxic contamination from Raritan Bay.

4 So that's for the record and
5 just also for the community anyone who
6 ever needs to reach our office I'm
7 Carolyn Fefferman and my contact
8 information, my telephone number is
9 973-645-3030. Thanks for having me.

10 (Applause.)

11 MS. SEPPI: Thank you,
12 Carolyn. And before I get to the
13 Mayor I understand that Senator
14 Thompson is also in the audience.

15 I don't know if you have any
16 remarks, but if you do you are
17 certainly welcome to come up and share
18 them because we're stalling for time.

19 SENATOR THOMPSON: I'll be
20 very brief.

21 MS. SEPPI: Thank you.

22 SENATOR THOMPSON: I would
23 just like to commend the Advisory
24 Committee members for the great work
25 that they have done and all the others

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2 that have been involved to bring this
3 to this point.

4 I agree with you that while
5 five years is a long time the rate at
6 which these things usually move that's
7 like lightning speed with it. And I
8 just encourage you to keep the
9 pressure on because I was with the
10 State Health Department for quite a
11 few years and while there one of the
12 programs that they had was testing
13 kits for lead poisoning.

14 So I know how hazardous lead
15 can be and how important it is to see
16 it's not representing risk to our
17 community.

18 So I would just say as my
19 football coach in high school used to
20 say, get the lead out.

21 (Applause.)

22 MS. SEPPI: Thank you,
23 Senator.

24 Well, things aren't looking
25 good I guess for our Power Point right

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2 now.

3 MR. SIVAK: We're going to do
4 old school.

5 MS. SEPPI: Old school. Oh,
6 like in the old days just talk, right.

7 Right now though I would like
8 to introduce the Mayor. He has been
9 very supportive and we worked very
10 cooperatively with him and I think he
11 has some remarks also. Mayor.

12 MAYOR HENRY: Thank you.
13 Thank you, everyone. Thank you, EPA.
14 Elected officials, thank you.

15 Tonight I just have a couple
16 of comments and the first comment is
17 to show and guarantee to the CAG,
18 again thank you. And to let you know
19 it's not only Ward 1. It's the entire
20 town this affects. This isn't good
21 for Ward 1, it's not good for Ward 6.
22 It has a negative impact on the entire
23 town. The entire town is behind
24 cleaning up this beach and getting
25 this, as Sam Thompson said getting

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2 lead out.

3 The second point I'd like to
4 make is we all know this is just the
5 first battle in a war that we're up
6 against here. Tonight we're going to
7 understand what they want to do, what
8 the EPA wants to do and as of right
9 now I'm fully in support of what they
10 want to do.

11 As I understand it, the second
12 phase is going to be how we're going
13 to do it. How we're going to do it
14 and that's also important because we
15 need to make sure that the cure for
16 this disease as I would like to call
17 it isn't going to be worse than the
18 disease itself. Are we going to be
19 left with an infrastructure after they
20 remove all this material from site.
21 So how they do it is just as important
22 as what they want to do.

23 And, finally, the most
24 important, probably the hardest battle
25 we're going to have to face as a town

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2 is when they're going to do it. When
3 are they going to do this and who is
4 going to pay for it. Those are the
5 battles yet to be fought.

6 So we need to keep up the
7 pressure. We need to keep up the
8 cooperation between all of us. We
9 can't splinter. That might be a
10 tactic, divide and conquer, it's not
11 going to happen here in Old Bridge.
12 We are all for this cleanup, to get it
13 done the best way possible and as
14 quick as possible. I know lightning
15 speed, five years. Too long, you
16 know, it's been five years too long to
17 see that fence.

18 MS. SEPPI: Three.

19 MAYOR HENRY: Still, three
20 years too long. So we need to get
21 this done. We're here to cooperate,
22 but at the same time we need to look
23 out for our interests, protect to
24 township of Old Bridge and residents
25 of Old Bridge. So that's my

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dedication to this project. I hope it happens in my term as the Mayor that we get this done and we're certainly going to do everything we can to get it done.

Congressman, Senator,
Representative, we need you, please.
Please. Thank you. Thank you,
everyone. I'll be up later. I have
some township wide concerns. When I
do hear the plan I have some comments
to make, so I shall return. Thank
you, everyone. Thank you.

(Applause.)

MS. SEPPI: Thank you, Mayor.
Thank you.

Now we're looking for another laptop. I think this is terrible. I'm sorry. I don't know how long we have planned for this meeting and something like this happens. But what I would like to do now, by the way, now that we are totally off the agenda. My name is Pat Seppi. I work

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2 EPA. I work in the Public Affairs
3 Office and I am the Community
4 Involvement Coordinator for this site.

5 And what I'd like is we have
6 the other people who are here from EPA
7 tonight will introduce themselves and
8 tell you what they're doing in respect
9 to this site.

10 MS. MITCHELL: Good evening,
11 everyone. My name is Tanya Mitchell
12 and I am the Remedial Project Manager
13 for the site.

14 MS. PENSAK: Hi. My name is
15 Mindy Pensak and I'm the Ecological
16 Risk Assessor for the site.

17 MS. SMITH: My name is Lora
18 Smith. I'm the Human Health Risk
19 Assessor.

20 MR. SCORCA: Mike Scorca,
21 EPA's hydrogeologist.

22 MS. SEPPI: Thanks, Mike.

23 MR. SIVAK: Hi. I'm Michael
24 Sivak. I'm the Section Chief for the
25 Mega Projects Team at Superfund which

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2 is dealing with the site.

3 MS. SEPPI: And other by the
4 table. Elias Rodriguez, wave. Elias
5 is the Superfund Press Officer.

6 So I think what we're going to
7 do in the meantime we might as well do
8 a little bit of overview about the
9 Superfund process.

10 I know a lot of you have heard
11 a lot of the information that is going
12 to be given to you tonight. We try to
13 keep our presentation short, truly we
14 do, but when we have a proposed plan
15 public meeting like this you can see a
16 lot of people from EPA are actually
17 involved in putting this plan
18 together.

19 So we ask your patience and it
20 might be a little bit long, but we
21 will try to get through it as quickly
22 as possible because of course the most
23 important thing for us to get to your
24 questions and comments.

25 Okay, Michael.

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2 MR. SIVAK: It was a really
3 good presentation too. Hopefully
4 we'll get to see it later.

5 The presentation tonight,
6 we're going to talk you through an
7 oral history of the site. We're going
8 to talk you through the results of our
9 remedial investigation which is a
10 study that defines the nature and the
11 extent of contamination associated
12 with the site.

13 We're going to talk you
14 through the feasibility study which is
15 an evaluation of all the different
16 remedial alternatives that we consider
17 for the Raritan Bay Slag Superfund
18 Site. We'll take you through the
19 results of the human health and the
20 ecological risk assessors. We have
21 those folks here.

22 We're going to walk you
23 through what our remedial action
24 objectives are for the site, what is
25 our goal in cleaning up the site, what

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2 are we going to try to achieve and
3 what levels are we going to try to
4 achieve. We're going to talk about
5 all of the remedial alternatives we
6 looked at and then we're going to go
7 through our proposed alternative that
8 was identified in the proposed plan.

9 The Superfund process is a
10 very lengthy process. There are many,
11 many steps to it. The step that we
12 are in right now and you have to
13 imagine a nice visual that looks like
14 little stepping stones down a path.
15 It's an awesome visual. It looks like
16 this. And you will see we have
17 finished up the remedial investigation
18 and feasibility study, so we now know
19 the nature, what kind of contamination
20 we have out there and where is that
21 contamination. And we looked as I
22 said all the different remedies that
23 are out there that would allow us to
24 clean up the site.

25 And so we have selected what

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2 we think is the best remedy for the
3 site. And we are right now in the
4 public comment period. We issued our
5 proposed plan with our preferred
6 remedy to the public and we are doing
7 a public meeting. We're here tonight
8 to talk to you about all the steps in
9 the process.

10 At the end of the public
11 comment period we will issue what is
12 known as a Record of Decision. We
13 call it a ROD and that document will
14 memorialize EPA's decision on what the
15 preferred remedy or what our final
16 remedy for the site will be and we'll
17 also include what we call our
18 responsiveness study which will
19 include all the comments we receive
20 during the public comment period, all
21 the comments that are noted tonight by
22 the stenographer as well as any
23 comments that are submitted to Tanya,
24 the Project Manager, either
25 electronically or by mail.

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2 So we will issue that Record
3 of Decision and that includes a
4 summary of our decision as well as a
5 record of all of the comments and our
6 responses to those comments.

7 The Raritan Bay slag is
8 approximately 1.5 miles in length. It
9 runs through Old Bridge and
10 Sayreville. Obviously many of you
11 know this. It is comprised of three
12 main sectors. These are described in
13 the proposed plan. We have the
14 seawall sector. We have what is
15 known -- I'm sorry, the seawall sector
16 is comprised of pieces of slag as well
17 as associated waste such as bricks and
18 cement and other materials.

19 We have the western jetty
20 which is at the Cheesequake Creek
21 inlet. That's a tough name. When I
22 first started on this project that was
23 one of the things I was most terrified
24 of pronouncing, Cheesequake. That's a
25 very tough name.

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2 We also have the Margaret's
3 Creek area. It's a 47-acre wetland
4 that also has been identified as
5 containing various piles of slag and
6 battery casings.

7 A brief history of the site.
8 In the late 1960's and early 1970's
9 slag was deposited along the seawall
10 and the western jetty. In 2007
11 elevated levels of -- elevated levels
12 of metals, primarily lead, were
13 identified by health agencies.

14 In 2008 EPA was asked to
15 evaluate the Lawrence Harbor seawall
16 for removal action under the
17 Comprehensive Environmental Response
18 and Liability Act which is the
19 Superfund. That's the actual name of
20 the Superfund law that you've heard
21 about this evening.

22 The Raritan Bay slag was
23 listed on the National Priorities List
24 on November 2, 2009 and we are here
25 this evening to take this site to the

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2 next step.

3 I'm going to turn it over to
4 Tanya Mitchell -- no, to Mike Scorca
5 who is our hydrogeologist on the site,
6 who is going to take us through some
7 of the findings of the remedial
8 investigation.

9 MR. SCORCA: Okay. I have a
10 brief presentation here of what some
11 of you have, information we learned
12 from the numerous studies that we
13 performed. I'm going to use this map
14 since we don't have the slides.

15 So as Mike described, this is
16 the western jetty area where the slag
17 was piled and this is the seawall area
18 where the other slag was a source.

19 This is Margaret's Creek area
20 and it's wetlands and this is where
21 they also found the --

22 A VOICE: Is there any chance
23 we can move that map.

24 MR. SIVAK: Sure.

25 Can everybody see one of the

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2 two maps.

3 A VOICE: You got to bring it
4 higher.

5 MR. SIVAK: Sure.

6 (Discussion off the record.)

7 MR. SCORCA: So hopefully that
8 helps orient to where we are looking
9 on this aerial photo.

10 So there is about a 30-foot
11 bluff along here, along the beach.
12 From there you get a slope down to the
13 beach area and a gentle slope out and
14 then below the bay, the floor of the
15 bay slopes gently out into Raritan
16 Bay.

17 The tidal fluctuation in
18 Raritan Bay is about five and a half
19 feet and because of that during low
20 tides the low, low tide, the area of
21 exposed bay bottom is about four to
22 600 feet in width.

23 Okay. We did a hydrodynamic
24 and sediment dynamic study using -- to
25 measure the currents in the bay. The

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2 currents are generated by waves and
3 tidal action.

4 Overall there is a -- there's
5 a westward direction of the current.
6 That's the main current, but with our
7 study we used acoustic Doppler
8 technology and we were able to
9 identify some areas of some more minor
10 currents that includes the current out
11 of Cheesequake Creek which is the net
12 major current towards the bay.

13 There is some minor currents
14 around the jetty, the western jetty.
15 There's the predominant current
16 westward which then is intersected by
17 the two -- the three jetties in here,
18 and with that you get deposition near
19 the site of the jetties.

20 MR. SPIEGEL: What time of
21 year did you do that study?

22 MR. SCORCA: I don't remember,
23 but that was -- so we have 12 slides
24 that you can see in the remedial
25 investigation report. That was the

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2 long-term average.

3 There was also a bit of a back
4 current in this direction as well and
5 then over here again westward is the
6 main direction.

7 We also did it during storm
8 activity and under those conditions
9 the currents change a little bit, the
10 westward current is even more enhanced
11 and there are some currents that are
12 directed bayward from the land along
13 the beach here that were observed.

14 And so in the -- if you look
15 in the RI you can see that it enhances
16 the currents we saw and it changes
17 directions during flow -- during
18 storms and the overall sediment
19 transport increases by about four
20 times during storm conditions.

21 So we also have a generalized
22 conception model which is an
23 illustration that you'll see in the
24 report, and that helps to show the
25 deposition zones which are such as by

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2 the beach area where the jetty slows
3 down the flow and the sediments build
4 up in that area and you can see some
5 other areas as well.

6 And also there is deposition
7 zones just offshore from Cheesequake
8 Creek inlet on either side of it as
9 well as over here by the western
10 jetty. So those are some of the main
11 deposition zones that you can see on
12 that figure.

13 We also did -- we did a lot of
14 investigations and studies of this
15 for this project. So I'm just going
16 to give a list here that we have a
17 slide for.

18 We did the hydrodynamics and
19 sediment dynamics study. We did a
20 slag characterization study where we
21 collected some slag and sent it to the
22 laboratory for analysis. We did a
23 slag distribution study. We did some
24 trenching along the seawall and we
25 looked to see what the distribution

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and extent of the slag was in this area. We did the exchange studies from Margaret's Creek and from Cheesequake Creek.

We also did some groundwater investigations and we put in 15 wells with well level recorders to observe tidal fluctuations. We did hundreds of soil, sediment, surface water samples to delineate the extent of the contaminated zones.

We did studies of biota and we also did bioavailability samples and we also had EPA's Technical Review Work Group, the TRW did lead depositing samples and background samples for media surface water, soil and ground water.

MR. SPIEGEL: The composite samples, was that in the bay itself or was that up in the Margaret's Creek area?

MS. SEPPI: Wait. Bob, I'm
sorry, I don't mean to interrupt.

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2 What we'd like to do is the
3 presentation first and then get to the
4 questions. Only because for one
5 reason because our stenographer needs
6 to have your name when you ask
7 questions. But sometimes the
8 questions get answered during the
9 presentation. So I know everybody has
10 questions, but if you can hold them I
11 would appreciate it.

12 MR. SPIEGEL: Sure.

13 MS. SEPPI: Thank you.

14 MR. SCORCA: So that list is
15 included in the proposed plan on the
16 table.

17 Okay, Tanya.

18 MS. SEPPI: Thank you. Good
19 evening, everyone. My name is Tanya
20 Mitchell and, as I said before, I'm
21 Remedial Project Manager for the site.
22 I'm going to speak with you guys about
23 the nature and extent of contamination
24 that we looked at at the site.

25 Initially we began looking at

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2 several different analytes such as
3 lead, arsenic, copper, antimony, and
4 chromium. We started looking at them
5 in the beginning because they were
6 known to be associated with the slag
7 source material and they were often
8 detected frequently in the media at
9 the site such as in the soil, the
10 sediment as well. Other metals are
11 also associated with lead and were
12 also detected, but at much lower
13 concentrations.

14 We also did some background
15 sampling which is in Area 10, this is
16 going to be difficult. This area
17 right here is Area 10 and we looked at
18 that area for background sampling and
19 we also looked at Whaler's Creek and
20 that is located right here.

21 We performed some test
22 excavations along the beach area which
23 would be an Area 2, all the way from
24 Area 2, 3, 4, and 1.

25 In the test excavation one or

12 We have, in the western jetty
13 we have slag that is covered on this
14 jetty here. Primarily all along this
15 jetty is covered with slag.

16 In this area here which is the
17 seawall sector slag is located from
18 here all the way down to Area 4. This
19 whole area is covered with slag. And
20 the Margaret's Creek area or Area 9, I
21 may say Area 9 or Margaret's Creek.
22 They mean the same. That's this area
23 here. Various piles of slag were
24 noted in this area. They were all
25 found in the upland portions of the

We have battery casings that

In addition to looking at the slag during the nature and extent we did some slag testing. We evaluated lead. Elevated levels of lead was identified in both the composite samples as well as in core samples of the slag and various leaching tests we performed such as a toxicity characteristic leaching procedure which is called TCLP or T-C-L-P.

We have battery casings that are also along the site and the battery casings we also performed some tests on that as well. We performed the TCLP test on the battery casings which also indicated that lead was

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2 leaching from the battery casings as
3 well.

4 Samples from the Margaret's
5 Creek sector and the western jetty
6 composite samples were both above the
7 TCLP limit of five micrograms per
8 liter -- per kilogram, I'm sorry.

9 The leaching tests, what do we
10 use the leaching tests for. It helps
11 us help to identify where the material
12 can be deposited. If we were going to
13 remove it from the site it helps us to
14 identify which disposal facilities we
15 can take those slag materials or
16 battery casings to.

17 I'm going to talk about now
18 the nature and extent of the seawall
19 sector and the seawall sector as I
20 said is in this area right here.
21 Battery casings were found in the
22 upper two inches of the depositional
23 zones in Area 2 and 5. The beachfront
24 total estimate volume of battery
25 casings is 70 cubic yards and of the

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2 slag we estimate it to be about 8
3 percent covered with slag.

4 Slag was observed in test
5 excavations on the upside of the
6 seawall in Area 1 and the eastern end
7 of Area 4.

8 Michael was pointing out, if
9 you want to look over there he'll
10 point out on the map where I'm
11 speaking of.

12 The highest concentrations of
13 soil and sediment was in the shallow
14 soils and sediment found in Area 2
15 near shore sediment and Area 5 near
16 the first jetty. For surface water
17 the highest lead concentrations were
18 in Areas 1 and 2.

19 Now, we're going to move to
20 the jetty sector which is more in the
21 Sayreville area where I said the jetty
22 was covered with slag. The slag was
23 observed on and to the west of the
24 main section of the western jetty and
25 it is comprised of about 80 to 90

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2 percent slag. So that jetty is
3 predominantly covered in slag.

4 Battery casings were observed
5 on the jetty and scattered nearby. So
6 it was not found like in piles. It
7 was just randomly scattered. The soil
8 and sediment in that area, the shallow
9 soils are most impacted by the lead
10 was on and adjacent to the western
11 jetty. In deeper soils the lead were
12 limited to the western jetty in Area 8
13 beach. The highest concentrations of
14 lead in the sediments was located on
15 the west of the western jetty.
16 Sediment concentration was observed in
17 portions of Area 8 and 7.

18 The surface water, the
19 majority of the surface water samples
20 collected from the jetty sector did
21 not exceed criteria. So the levels of
22 lead in that area was very much lower
23 for the surface water.

24 In Margaret's Creek which is
25 Area 9 slag was observed in multiple

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2 discrete piles within Margaret's Creek
3 upland soils.

4 Battery casings were also
5 observed scattered near the piles of
6 slag approximately about 250 cubic
7 yards to be exact. No slag or battery
8 casings were observed in the wetlands
9 sediment.

10 For the soil in this area no
11 slag or battery casings were observed
12 in the wetland sediment. Soil
13 contamination was observed adjacent to
14 the slag piles.

15 The surface water, there were
16 very few minor samples that were
17 collected from within the area near
18 Margaret's Creek that exceeded the
19 lead criteria. So it was not, the
20 surface water was not as heavily
21 contaminated in that area.

22 After we looked at the nature
23 and extent, then we move on to the
24 risk assessments.

25 Now, we're going to have

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2 someone regarding human health and
3 followed by the eco risk assessment.

4 MS. SMITH: Thank you.

5 EPA performed a human health
6 risk assessment to evaluate the risk
7 to folks that are either exposed
8 currently or in the future.

9 So some of the current land
10 use scenarios that we evaluate at the
11 site are recreational users, that is
12 people using the beach, walking in the
13 water, walking their dogs in Areas 1
14 which is known as Seawall, three,
15 which is the playground area, four,
16 which is the park area, five and six
17 which are the additional beach areas,
18 and Area 9 which is Margaret's Creek.

19 We also evaluated angulars
20 throughout the site. These are people
21 that are either fishing for various
22 things like bluefish and stripers,
23 thank you. Also we looked at
24 different shellfish like mussels and
25 clams as well. So we looked at

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2 angulars throughout the site except
3 for Areas 3 and 4 which should be only
4 two ground walked areas.

5 We also evaluated pedestrians
6 throughout the site separate from
7 recreational areas in all areas except
8 for two, which is the closed beach,
9 eight which is the adjacent to western
10 jetty, and 11 which just beyond that.
11 These are the areas that are currently
12 fenced off so folks don't have access
13 to those very readily, but we did
14 evaluate trespassers in these areas
15 because while they shouldn't be going
16 there we must assume that someone
17 might jump the fence.

18 We evaluated outdoor workers
19 in Areas 3 and 4. That's the
20 playground area and the park area and
21 also construction and utility workers
22 throughout the site. For future use
23 scenario we evaluated all of the same
24 scenarios from the current use except
25 the only changes were we looked at the

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2 Area 2 beach for recreational use
3 assuming that it will be open in the
4 future and we also evaluated
5 groundwater at the site for drinking
6 water purposes to the residents.

7 So our conclusion was that
8 lead and soil is the sole risk driver
9 at the site. There are lead modeling.
10 We determined that future child
11 recreational users in Area 2 which is
12 currently the closed beach and current
13 and future female construction or
14 utility workers who may be pregnant,
15 they also have potential lead risks
16 above a level of concern.

17 And as I mentioned we did do a
18 biota study and looked at fish and
19 shellfish in the area, and found there
20 is no unacceptable risk related to
21 consuming either fish or shellfish in
22 the area.

23 I think we're going to go on
24 to the ecological risk assessment now.

25 MS. PENSAK: Ecological risk

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2 assessment is the way that we evaluate
3 whether contaminants present in media
4 at the site pose unacceptable risk to
5 both wildlife and plants and all our
6 risk assessments follow agency
7 guidance.

8 Now, there were three areas in
9 particular that we looked at for the
10 ecological risk assessment, presence
11 of slag and battery casings as well as
12 the desirable habitat for our
13 receptors. So we looked at Area 1,
14 the seawall sector; Area 8, the area
15 north of the western jetty and of
16 course the Margaret's Creek wetland
17 area, Area 9.

18 When we evaluate risk we do it
19 in two ways. First we screen
20 contaminants that we identified in the
21 sediment, surface water and soil
22 against applicable screening values
23 that are put out there by the State as
24 well as the Federal government and
25 then also do food chain models to

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2 determine whether their risk to
3 organisms that would use the site such
4 as the American robin and the
5 (inaudible). So what did we find out.

6 Well, in all three areas,
7 Areas 1, 8, and 9 we had surface water
8 contaminants of concern; primarily
9 inorganics, lead, arsenic, copper, and
10 zinc. Within the bay areas, Areas 1
11 and 8 we found one contaminant of
12 concern and that was lead and within
13 the Margaret's Creek area in the soil
14 we found that lead was a contaminant
15 of concern.

16 Now, Tanya will continue.

17 MS. MITCHELL: I'm going to be
18 speaking about the remedial action
19 objectives. In the proposed plan
20 there is a section on remedial action
21 objectives and this sort of follows
22 that section.

23 Before we can begin talking
24 about remedial action objectives we
25 must first define what principal

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2 threat wastes are. And what they are,
3 principal threat wastes are those
4 source materials considered to be
5 highly toxic or highly mobile that
6 generally cannot be readily contained
7 or would present a significant risk to
8 human health or the environment should
9 exposure occur.

10 The remedial action objectives
11 that we have for the site is No. 1 is
12 to remove or treat material that meets
13 the definition of principal threat
14 waste to the extent practical and to
15 prevent current or potential future
16 migration of that material that meets
17 the definition of principal threat
18 waste from the site that would result
19 in a direct contact or inhalation
20 exposure to the extent practical.

21 Now, when we looked at the
22 site we came up with slag and battery
23 casings as needing to have a remedial
24 action objective, and for slag and
25 battery casings along with the

1 Proceedings

2 associated waste we determined that we
3 would reduce exposure resulting from
4 incidental ingestion to levels that
5 are protective of human health in
6 ecological receptors.

7 In addition, we would reduce
8 migration of contamination from slag
9 and battery casings to surface, water,
10 soil and sediments to levels that are
11 protective of human health in
12 ecological receptors.

13 Once we identified soil as
14 also needing a remedial action
15 objective we determined that we would
16 reduce exposure from inhalation and
17 incidental ingestion of contaminated
18 soil to levels protective of human
19 health.

20 Reduce exposure from the
21 ingestion of contaminated soil and
22 ingestion of contaminants via the food
23 chain to levels protective of
24 ecological receptors, and we would
25 also reduce migration of contamination

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2 from the soil to surface water and
3 sediment to levels that are protective
4 of human health in ecological
5 receptors.

6 In addition to now we have,
7 we're looking at the slag and battery
8 casings and we looked at the soil. So
9 now we still need to deal with the
10 sediment because sediment also poses
11 some concern for us.

12 So for sediment we are going
13 to reduce exposure from the ingestion
14 of contaminated sediments and
15 ingestion of contaminants via the food
16 chain to levels protective of
17 ecological receptors, reduce the
18 migration of contaminants to sediments
19 to surface water and soils to levels
20 that are protective of human health
21 and ecological receptors.

22 For surface water we are
23 planning to reduce metals
24 concentrations to levels that are
25 protective of ecological receptors by

1 Proceedings

2 remediating source materials.

3 As we develop our remedial
4 action objectives, now we need to move
5 on to our remediation cleanup levels.
6 Remediation cleanup goals include the
7 removal of slag and battery casings
8 and associated waste, remediation of
9 surface water.

10 The approach to the
11 remediation of surface water is to
12 remove the principal threat waste,
13 that is the slag and the battery
14 casings that act as sources of
15 contamination to the surface water.
16 This will reduce the surface water
17 contaminations over time to acceptable
18 levels.

19 When we started looking at the
20 soil and sediment a two-step process
21 was used to develop the preliminary
22 remediation goal which aimed to
23 collectively address the entire site
24 as a whole regardless of the media,
25 whether it was soil or whether it was

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2 sediment.

3 In the first step a PRG, which
4 is a primary remediation goal, was
5 derived based on parameters specific
6 to each soil or sediment. Due to the
7 nature of the site there is a
8 commingling relationship between soil
9 and sediment in the intertidal zone
10 areas, meaning there is significant
11 potential for recontamination of soil
12 or sediment if the two media were
13 remediated to different cleanup
14 levels. Therefore, one single unified
15 remediation cleanup level is provided
16 for.

17 If you look at your table in
18 your pamphlet with the proposed plan
19 you will see a table in there in which
20 the table identifies the contaminants
21 and cleanup levels for soil, sediment,
22 and surface water.

23 For soil 400 milligrams per
24 kilogram is the unified cleanup level
25 for lead in soil and sediment. So we

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2 will be using 400 for both. And the
3 cleanup level for lead in surface
4 water is 24 micrograms per liter and
5 there are additional metals there also
6 for surface water and you can take a
7 look at those in that table.

8 MR. SIVAK: That's Table 1 in
9 the proposed plan.

10 MS. MITCHELL: In addition
11 after we identified our remediation
12 cleanup levels we moved on to start
13 looking at our remedial alternatives.

14 The first remedial alternative
15 we have is a no action. In the no
16 action, we have to have a no action
17 and no action, what it means is that
18 we would leave the site exactly the
19 way it is. We would not maintain a
20 fence. We would not remove any slag.
21 We would not remove any soil. We
22 would leave it exactly the way it is
23 in its current condition. That is a
24 required alternative under CIRCLA.

25 For Alternative 2 which is

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2 excavation and dredging, off-site
3 disposal and monitoring. In this
4 alternative slag and battery casings
5 and contaminated soil and sediment
6 will be disposed of off-site. Surface
7 water will be monitored to assess
8 impacts from remedial activities and
9 insure concentration levels are within
10 acceptable levels.

11 Now, this alternative as you
12 see in the proposed plan is 78.7
13 million and it takes approximately two
14 years to complete.

15 Under Alternative 3 we looked
16 at excavation and dredging, on-site
17 contaminant of source materials,
18 off-site disposal of soil and
19 sediment, institutional patrols and
20 long-term monitoring.

21 And under this alternative the
22 slag and battery casings would be
23 placed in a containment cell located
24 in the upper portions of Margaret's
25 Creek and the jetty sector, which

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2 means what we would do is the slag and
3 battery casings that's on the seawall
4 and contained in Margaret's Creek,
5 Area 9, those materials would go into
6 a containment cell in Area 9 in this
7 area and the slag and battery casings
8 that were located on the western jetty
9 will be placed in its own containment
10 cell right here in the upland portions
11 of this Area 8. So we would not cross
12 township lines.

13 Under Alternative 4 excavation
14 and dredging, on-site containment,
15 off-site disposal and capping,
16 institutional patrol, long-term
17 monitoring.

18 Slag and battery casings,
19 contaminated soil and sediment from
20 the seawall sector from Margaret's
21 Creek will again be placed in a
22 containment cell in the upland
23 portions of Margaret's Creek in the
24 jetty sector in their separate
25 locations.

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2 The slag and battery casings,
3 contaminated soil and sediment from
4 the jetty sector, as I said, will be
5 in its own cell in Sayreville. So we
6 wouldn't move the slag from Sayreville
7 to Old Bridge or Old Bridge to
8 Sayreville. But the difference in
9 this containment, in this alternative
10 is the capping.

11 Area 8 sediments located in
12 the jetty sector will be capped.
13 That's the significance difference in
14 this alternative.

15 In Alternative 5 which is
16 excavation and dredging, on-site
17 contaminant, off-site disposal,
18 institutional patrols and long-term
19 monitoring. This is similar to
20 Alternative 4 and the slag and battery
21 casings, contaminated soil and
22 sediment will be placed in their
23 respective containment cells in the
24 upland portion of Margaret's Creek and
25 the jetty sector.

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2 Surface water will be
3 monitored to assess impact from
4 remedial activities and to insure
5 concentrations are within acceptable
6 limits. The differences here is there
7 is no capping.

8 Once we finish looking at our
9 alternatives, then we have to look at
10 the nine criteria. Some of you are
11 familiar with the nine criteria. I
12 have spoken to our Community Advisory
13 Group about the nine criteria that we
14 have to compare all of our
15 alternatives against.

16 Unfortunately, I have a slide
17 presentation, but -- with a comparison
18 for you, but unfortunately I can't
19 show that to you at this moment.

20 EPA compared all of the
21 alternatives against the nine
22 criteria. Two of the criteria are not
23 displayed in the table which is --
24 which I'll talk to you about it in a
25 few minutes, but the nine criteria

Now, all of the alternatives

Alternative 2 most effectively

meets the first seven evaluation
criteria. Alternative 2 will allow

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2 the site to be restored to
3 unrestricted use, the potential for
4 leaching will be eliminated due to the
5 removal and off-site disposal of all
6 slag, battery casings, and
7 contaminated soil and sediments.
8 Implementation is about two years with
9 an estimated cost of 78.7 million.

10 The other two criteria that I
11 wanted to mention to you is State
12 acceptance and community acceptance.
13 EPA will seek State acceptance and
14 concurrence on the Record of Decision
15 with the State. The community
16 acceptance is why we're here tonight.

17 The community is encouraged to
18 provide comment on the proposed plan.
19 EPA in consultation with the State may
20 modify or select another alternative
21 based on the new information or input
22 from the community. More details can
23 be found in the proposed plan in which
24 you have and the administrative
25 record.

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2 The administrative record is a
3 list of several documents that are
4 available to you in the local
5 repositories. We have the remedial
6 investigation which Michael Scorca
7 referred to earlier. We have the
8 feasibility study, that's also there,
9 and we have several of the reports
10 that is associated with some of the
11 tests that we conducted at the site.
12 All of those documents are available
13 to you in the local repositories.

14 In addition, I'm sorry about
15 tonight in the presentation the slide,
16 but I will put the presentation on the
17 website and I hope to have that posted
18 on Monday.

19 To move forward I'll have Pat
20 give you some additional details about
21 the comment period.

22 MS. SEPPI: Thank you, Tanya.

23 Well, that wasn't as bad as I
24 thought it was going to be without
25 having the overhead. It was kind of

One of the other things I

So, you know, if you go home

tonight, maybe think of some more
comments that you didn't share with us
this evening and you like to send them
to Tanya you can either e-mail them to
her or you can mail them to her in

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2 regular mail, but now you have until
3 November 27th to do that.

4 Just before we start do you
5 need a break before we start.

6 (Discussion off the record.)

7 MS. SEPPI: So what I'm going
8 to ask is would you please come up
9 front with your question or your
10 comment, spell your name and then, you
11 know, please go ahead and ask your
12 question or give us your comment and
13 we'll do the best we can to answer
14 your questions. So let's just try to
15 do it kind of in an orderly fashion.

16 Do you want to start up front.
17 Anybody here want to come up with a
18 question. Over here. No. Phil.

19 MR. KLIMEK: Good evening. I
20 am resident of Cliffwood Beach, Old
21 Bridge Township. First name is Philip
22 with one L, last name is Klimek,
23 K-L-I-M-E-K.

24 I do appreciate the effort and
25 all of the actions of the EPA. In

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2 addition to being a resident I'm also
3 a member now of the Community Action
4 Group and academically or
5 professionally an environmental
6 engineer. So I have 35 years
7 experience in the chemical industry in
8 New Jersey before now joining the
9 Department of Defense.

10 But I want to laud the EPA on
11 their efforts. It is a very rapid
12 approach I should say. I know it
13 doesn't seem that way. As a resident
14 I'm saying please give me a chance,
15 but I also sincerely support
16 Alternative 2 which is remove the
17 contaminants, take them off-site, for
18 the simple reason that if we cap them
19 on-site, have a storm, the cap is
20 gone, everything is washed right back
21 down and you will have spent a
22 slightly smaller amount of money and
23 now you're in the same position you
24 were before you started only less that
25 much money. Whatever it costs it will

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2 all have been wasted.

3 Therefore, do it now, do it
4 right. If it takes a little longer it
5 takes a little longer, but at least
6 it's done and it's done permanently
7 and for that I say thank you.

8 (Applause.)

9 MS. SEPPI: Thank you, Phil.

10 You know, I would be remiss
11 before the next person comes up
12 because I got kind of messed up with
13 the agenda. But if I didn't mention
14 as Connie said, the western part of
15 the site, the western jetty is in
16 Sayreville. We have representation
17 from Sayreville on our Community
18 Advisory Group. And I just wanted to
19 let you know that I did speak to the
20 Mayor's Office. He had a previous
21 engagement. He would have liked to
22 have been here tonight, you know, and
23 even make some remarks and he
24 expressed his regret for that. Please
25 so know that there are representatives

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2 from Sayreville and there may be
3 people from there that I don't know.
4 Thank you.

5 Donna.

6 MS. WILSON: My name is Donna,
7 D-O-N-N-A, Wilson, W-I-L-S-O-N. And
8 I'm here for the Community Advisory
9 Group. Hi, everybody. Thank you for
10 this opportunity to comment on the
11 EPA's proposed plan for the Raritan
12 Bay Slag Site. I'm Donna Wilson and
13 the current facilitator of the 24 or
14 so member Community Advisory Group or
15 CAG.

16 We started getting nearly
17 three years ago for the purpose of
18 advising EPA regarding ongoing study,
19 testing, and cleanup plan formulation
20 on behalf of our community as well as
21 being a conduit for updating the
22 greater community on these activities.

23 We are optimistic, albeit
24 cautiously so that our passionate work
25 to defend the community is succeeding.

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2 We wanted the right solution for us,
3 our children, their children and the
4 environment and it appears that the
5 right solution is indeed the
6 alternative which was chosen.

7 Having dedicated three years
8 of our lives to fighting for a proper
9 cleanup of the community we are happy
10 and relieved that Alternative 2 which
11 calls for removal of the source
12 contaminants and concentrated soil and
13 sediment was chosen over landfilling
14 material in place.

15 Landfilling contaminants in
16 tidal wetlands known for flooding
17 would not be protective of us, our
18 children, their children and the
19 environment and we'll get our beach
20 back.

21 While our quality of life and
22 property values have been temporarily
23 affected by the fence and will
24 continue to be affected during
25 cleanup, they would have been

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2 permanently affected if a hazardous
3 landfill was placed in the Margaret's
4 Creek area, Sayreville or anywhere
5 nearby.

6 Now that the plan calls for
7 the material to be removed rather than
8 buried by Margaret's Creek that area
9 will remain free to absorb water. A
10 landfill would have increased the
11 severity of flooding, erosion and
12 tidal events and severely impacted
13 properties of Cliffwood Beach,
14 Lawrence Harbor, and the surrounding
15 areas.

16 No longer will we have to fear
17 health and environmental impacts from
18 the contamination. No longer we need
19 to worry that a low budget landfill
20 situated in the wrong location would
21 cause flooding and erosion near homes,
22 businesses and active recreation area.

23 No longer will be concerned
24 about storm events re-releasing these
25 contaminants into the area and our

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2 community will not have to suffer the
3 stigma of a toxic wasteland fill near
4 our homes and businesses.

5 Waterfronts and wetlands are
6 precious commodities and we are
7 delighted that they will be returned
8 to us.

9 Margaret's Creek will remain a
10 natural protected area allowing its
11 wetlands to control storm water and
12 flood tides as well as provide a home
13 for native animals and the ecosystems
14 they inhabit.

15 Sayreville's waterfront site
16 will not be forever buried under a
17 hazardous landfill, but free for
18 future use.

19 This solution might not be the
20 quickest, but it's the most
21 appropriate solution leaving us
22 without the problems of a smash and
23 grab cleanup, and so far the
24 Superfund's process for this site is
25 moving faster than for most other

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2 Superfund sites in Jersey. We hope
3 that momentum keeps up.

4 We still have some work ahead
5 of us. CAG will continue to campaign
6 for proper restoration of the uplands,
7 wetlands, seawall and beach actions
8 not yet detailed in any of the
9 alternatives. But Alternative 2 is
10 the right option, not just for
11 Lawrence Harbor and Old Bridge, and
12 Sayreville as a whole, but for all who
13 enjoy the park and surrounding natural
14 areas.

15 And we would like to take this
16 opportunity to heartedly thank the
17 staff of the Environmental Protection
18 Agency for its efforts on behalf of
19 our community, particularly Tanya
20 Mitchell and Pat Seppi for their in
21 tireless work with our group. Our
22 excessive questioning and highly
23 animated discussions must have surely
24 tried their patience and we are
25 grateful they continue to engage us in

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2 spite of that.

3 We would like to recognize the
4 New York/New Jersey Baykeeper,
5 Wetlands Association and Raritan
6 Riverkeeper for joining our CAG and
7 for their advice and guidance during
8 this process.

9 Finally, we would like to
10 thank the officials of the town of Old
11 Bridge, Mayor Owen Henry and his
12 administration as well as former
13 mayors Gillespie and Philips,
14 Congressman Pallone and Senators
15 Melendez and Thompson for keeping us
16 on their radar.

17 We would also like to thank
18 the public for their support in this
19 and invite them to attend our meetings
20 which are generally held the second
21 Tuesday of the month in the Lawrence
22 Harbor Recreation area at 6:30.

23 The EPA is taking the right
24 step here and we look forward to
25 working with you on the next right

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2 step. Thank you.

3 (Applause.)

4 MS. SEPPI: Thank you, Donna.

5 Very nice, thank you.

6 Yes.

7 MS. SEILER: Hi. My name is

8 Linda Seiler, L-I-N-D-A, S-E-I-L-E-R.

9 And I want to thank people I haven't
10 met today, Donna and Phil.

11 My mother and I live in Ward
12 4, but for years and years and years
13 we have spent time down at the harbor,
14 not just ourselves, but bringing
15 friends and it's been a shame these
16 last few years that we haven't. I
17 haven't been able to attend meetings.
18 I happened to attend Board of
19 Education meetings that day, but I am
20 so grateful that there are people, the
21 people who stood up here and the rest
22 of the committee that represented the
23 needs of all Old Bridge residents.

24 We are eternally grateful to
25 you and to the EPA and I thank John

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2 Corzine for finding Ms. Jackson and
3 having her elevated by President Obama
4 and that's all I have to say.

5 I was an engineer. This is
6 not my expertise, but it sounds so
7 reasoned and so right that I'm willing
8 to go on blind faith that the right
9 choice has been made. Thank you.

10 (Applause.)

11 MS. SEPPI: Thank you.

12 Bob.

13 MR. SPIEGEL: My name is Bob
14 Spiegel, S-P-I-E-G-E-L. However, you
15 can spell it however you want. I'm
16 the Executive Director of the Edison
17 Wetland Association and I have been
18 involved with this site for quite some
19 time and I see many of phases here and
20 that have come out when the need first
21 broke about this issue and the slag
22 that was deposited throughout this
23 whole area and I have to tell you that
24 I have a much different opinion in
25 terms of the EPA staff.

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2 When I first initially had
3 come out several years ago I was very
4 leary of the folks that they had
5 working this case because I knew it
6 was a big site. It was extremely
7 complicated. It had a lot of moving
8 parts and it was going to be very,
9 very expensive to clean up. But the
10 team that EPA put on this was, in
11 fact, their best and they were able to
12 do something that I have never seen
13 before; which is get a timeline that,
14 you know, I know it seems like a long
15 time to live with this nightmare, but
16 the timeline for the point at which
17 they started to tonight is by far in
18 my 20 years of history with cleanup
19 Superfund sites around the country is
20 the quickest, absolutely by far the
21 quickest I have seen EPA move from
22 beginning to decision.

23 And, you know, this really
24 should be an example of how to get
25 investigations complete and get to

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2 construction for the rest of the
3 country because EPA did something,
4 they stepped outside of their
5 bureaucratic box and they had their
6 removal team do a lot of the work that
7 was needed to get the investigation
8 done and worked hand in hand, you
9 know, to have a hybrid so that the
10 cleanup could get to the decision
11 point and I applaud them for that.

12 They really deserve a lot of
13 credit and we should appreciate the
14 fact that this took a lot of resources
15 internally for EPA to get that.

16 Removal has a certain amount
17 of money. Remedial has a certain
18 amount of money. Superfund as a whole
19 as Congressman Pallone had said and
20 many people know that work in this
21 issue it really isn't a Superfund
22 anymore. It's not. It doesn't exist.

23 We, the taxpayers, have to pay
24 when responsible parties are not
25 willing or viable and, unfortunately,

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2 we do.

3 We need a Superfund for sites
4 just like this because this cleanup is
5 going to be expensive. It needs to be
6 paid for and those who caused the
7 pollution should be the ones
8 responsible for cleaning it up. It
9 shouldn't be the taxpayers. It should
10 be the parties like National Lead and
11 the other responsible parties at
12 Superfund sites.

13 So that's just my page for
14 Superfund because I work on sites
15 across the State and across the
16 Country and many, many sites where we
17 don't have the level of EPA
18 involvement or the resources that EPA
19 has put into this site so they do
20 consider it a priority.

21 I think it was the Mayor that
22 said get the lead out and that is
23 definitely a term I agree with. You
24 know, the slag, it needs to come out.
25 It needs to come out as quick as

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2 possible and as safely as possible.

3 And I have just a couple of
4 questions and the technical end, we
5 have Rich Chapin from Chapin
6 Engineering somewhere in the audience,
7 oh, there he is, who is going to come
8 up. We contracted out Rich to look at
9 the plan and to just give us his
10 comments.

11 And this is one of the rare
12 exceptions where we're not going to
13 sit and nitpick for the planning
14 because it's a pretty good plan, get
15 it out of beach, get it out of the
16 harbor, restore the ecosystem, restore
17 the property values, restore this area
18 as an eco designation and move on with
19 our lives. That's the plan. Just how
20 do we do it. What's the quickest way
21 to do it and the best way to do it.

22 I just had one issue that I
23 saw right from day one has always been
24 how do we do this with the least
25 amount of impact to the community.

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2 You know, how do we remove the slag.
3 How do we work around schools, around
4 people who want to recreate here.

5 Every time I go down here to
6 the waterfront it's beautiful. It's
7 just -- it's a magnet for me. So how
8 do we best remove these kettle
9 bottoms, remove the sediment, and do
10 it in a way that doesn't leave the
11 community with negative impacts.

12 And I would like to recommend
13 and I think EPA is already looking at
14 this, that they try to do as much as
15 possible by barge and, if possible,
16 all of it by barge because it could be
17 I think done in a way where there is
18 no impact or low impact to the roads
19 and to the schools and to the kids and
20 to the people, the traffic that
21 already exists in this area and it's
22 going to take probably a couple of --
23 a year or two at least of work to get
24 this stuff out.

25 It would be best if the EPA to

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2 look at an intramodel way of removal
3 and they have done this at many, many
4 sites where they look at different
5 innovative ways besides just trucking
6 it out. Right across the river in
7 Sayreville actually over here in
8 Sayreville. When they had to clean up
9 the Horseshoe Road Superfund Site they
10 used an existing rail spur built on
11 the end of it and then offloaded
12 almost all the material and avoided
13 the roads all together just by
14 extending the rail spur and they did
15 that quite often.

16 With this particular site the
17 EPA needs to look at and require
18 National Lead if they are the ones
19 that are going to be doing the cleanup
20 to come up with a plan that really
21 looks to make this as easy as
22 possible, but as also as least
23 intrusive as possible.

24 We want the cleanup to go
25 forward. We want it to go forward in

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2 a way that doesn't inconvenience you
3 because you've already been
4 inconvenienced enough. Just this site
5 here has been a major inconvenience.
6 It's really just stopped a lot of
7 people's lives dead in their tracks
8 and it's been, you know, a scar on
9 this community.

10 As EPA moves forward with this
11 I would like to see them require this
12 cleanup, if possible, to be done by
13 using barges, by using, you know, ways
14 that they can come in from the water
15 if possible and then offload the
16 material somewhere else at a second
17 party area where they can stage it and
18 maybe in an area where there is a
19 freight yard already and then offload
20 it and take it away so that it's not
21 impacting your community, it's not
22 destroying your roads, it's not going
23 to be a major inconvenience to the
24 public, to the people that are using
25 this area, to the people that live

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2 here and I think that that could be
3 done.

4 The EPA should require it as
5 part of this plan so that we have a
6 well thought out plan and a well
7 executed plan and one that puts the
8 least amount of inconvenience on you
9 and the community and the people that
10 live here and the families that are
11 looking forward to the point of this
12 cleanup being done and over with.

13 I support this proposal. I
14 think we all should support this
15 proposal wholeheartedly because this
16 is the gold standard for cleanup for
17 this.

18 It's one that is going to not
19 only protect the environment, not
20 only, you know, give you a healthy
21 environment again where you can come
22 down and not have to worry about it,
23 but it's also going to restore
24 property values and it's going to help
25 with issues that many folks have

1 Proceedings

2 suffered from when you have a stigma
3 of Superfund site in your community
4 and the property values are going to
5 come back once it's been done.

6 I have seen it happen in many
7 Superfund sites where the cleanups
8 were done right and the issues
9 regarding them disappear when they're
10 done and the cleanups are finished.
11 And I look forward to the day when the
12 community can go down to the
13 waterfront, there is no areas that are
14 off limits, that you could enjoy the
15 beautiful promenade that's there and I
16 want to just thank the EPA for their
17 good work.

18 MS. SEPPI: Thank you, Bob. I
19 wasn't trying to rush you. I just
20 want to make sure everybody has a
21 chance to speak.

22 MR. SIEGEL: It wouldn't be
23 the first time.

24 MS. SEPPI: Anybody else over
25 here have a comment. Samantha.

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2 MS. MANBURG: Thanks, Pat.

3 My name is Samantha Manburg;

4 S-A-M-A-N-T-H-A, M-A-N-B-U-R-G. I am
5 the co-facilitator right now of the
6 Community Advisory Group and I'm a
7 resident of Lawrence Harbor. My house
8 is the closest to the actual
9 contamination of all the houses. It's
10 practically right in my backyard.

11 Because of that I am
12 particularly concerned and I knew that
13 if they were going to build a landfill
14 it was going to be pretty much not
15 directly behind my house, but just
16 across the water right behind my
17 house. They would be taking trucks
18 from right behind my house and moving
19 it to a landfill that was a little bit
20 further behind my house.

21 So out of all the options that
22 have been considered, none of us like
23 the situation. We don't like that the
24 lead was put there back in '69. We
25 don't like that it's been breaking

1 Proceedings

2 down in the tidal zone for the last
3 how many years was that, 40 years.

4 Out of all the options that
5 were available to us, leaving it
6 there, putting it on -- digging it up
7 and putting it on-site or digging it
8 up and taking it off-site, I think
9 there is a general consensus among the
10 community that this is the best
11 option.

12 I do have some concerns about
13 it just going through the -- you know,
14 working so closely with the EPA for
15 the last three years and studying all
16 the documents that they brought to us
17 and all of the studies that they did,
18 the feasibility study, the original or
19 the draft feasibility study that they
20 put out had a higher threshold or, I'm
21 sorry, a lower threshold. They were
22 going to do a more thorough cleanup of
23 the actual contamination which in the
24 practice would probably mean they
25 would be taking more sediment away.

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Pretty much in all the scenarios they would be taking away the actual slag, but with the lower contamination threshold they would be taking more sediment away.

It would be more disruptive of the environment and the community. There would be more truckloads going out. A big difference. But what they eventually settled on in the current proposal is to have a higher threshold which means the cleanup will not be as quite as thorough. There will be more contamination left behind, but I think overall it is something that everything is more pleased with because it will be a faster cleanup.

They will be able to take the contamination off-site because it is a smaller volume and it will be less expensive.

So overall I think it was a good compromise, but just to give everyone an idea of what the volumes

1 Proceedings

2 were, the original volume estimate for
3 taking all material off-site, just
4 overall all the material was
5 277,000 cubic yards and the current
6 estimate at the higher threshold is
7 92,000 cubic yards that will be moved.
8 So it's actually a third of what they
9 were originally looking at.

10 This is just a point that I
11 think is important to bring up to the
12 community so that you could understand
13 the thought processes that have been
14 gone through and that it's just where
15 we have come from and where we are
16 now, so it doesn't just look like a
17 panacea. It's good, but it is a
18 compromise.

19 And then where did Bob go.
20 Bob, we have been talking about barges
21 since day one. Day one. We have been
22 like bring in the barge, but EPA has
23 not thought that is going to be a
24 feasible solution. But maybe they'll
25 change their mind.

1 Proceedings

2 A few questions I have for the
3 EPA just because I wasn't quite clear
4 on it on reading all of the
5 documentation. I'm wondering why
6 there are no thresholds for metals
7 other than lead in the cleanup
8 options.

9 There was a lot of wording
10 that there would be no monitoring in
11 the proposed plan and I don't know if
12 this really means there will be no
13 monitoring or if that was just a
14 portion.

15 That is something I would like
16 answered and there was a lot of
17 discussion or at least three times it
18 was mentioned in the proposed plan
19 that there would be no replacement of
20 the wetlands sediments in the
21 Margaret's Creek area and that's
22 something else I would like elaborated
23 on because I don't quite understand
24 what that means.

25 But again out of all the

1 Proceedings

2 alternatives I do think this is the
3 best one and I am pleased. So
4 hopefully the dump trucks won't be in
5 my backyard for too long. Thank you.

6 MS. SEPPI: Do you want them
7 to answer your questions?

8 MS. MANBURG: Sure.

9 MS. PENSAK: I just wanted to
10 respond a bit to your statement that
11 it was a compromise.

12 When the original feasibility
13 study came out, that was based upon
14 screening level risk assessment and
15 when I came to the public meeting that
16 we had I talked a little bit about the
17 conservative nature of those numbers.

18 In addition to screening level
19 risk assessment, before we come up
20 with a preliminary remedial goal we
21 like to do a baseline ecological risk
22 assessment. In this case it was
23 called the final addendum to the final
24 screening level risk assessment and
25 one of it is we used actual tissue

1 Proceedings

2 data that was collected on-site along
3 with more realistic assumptions. I
4 talked a little bit last time about
5 toxicity reference values and how they
6 are derived. This is very dry
7 material so I'm trying to get through
8 it very quickly.

9 But the short end of this is
10 we did recalculations. Based on the
11 receptors of concern, based on
12 toxicity values and that's how the
13 number was derived. It was actually a
14 number of 401 that was derived for
15 ecological risk, the number for human
16 health was 400, so we settled on the
17 400.

18 I would be more than happy to
19 address any specific concerns you have
20 with that, but if you have not seen
21 this document your consultant has it.
22 This is where the information is.

23 MS. MANBURG: Okay. So would
24 you like to correct something that I
25 have said for the record.

1 Proceedings

2 MS. PENSAK: For the record
3 the cleanup number that we came up
4 with is not a compromise. It's based
5 on sound scientific decisions and risk
6 calculations.

7 MS. MANBURG: Okay.

8 MR. SIVAK: And since we're in
9 the follow-up, you mentioned I wrote
10 on two other things. Why there are no
11 cleanup goals for any metals other
12 than lead.

13 Well, we went through --

14 MS. MANBURG: In the soil.

15 MR. SIVAK: In the soils,
16 okay. There are a couple reasons why
17 we would develop cleanup goals at
18 sites and one of those reasons is we
19 would have an unacceptable risk to
20 ecological or human receptors.

21 And when Lora did her
22 presentation on the human health risk
23 the only -- she had identified that
24 the only chemical that was driving any
25 kind of an unacceptable risk from

1 Proceedings

2 exposure to soils was lead. There was
3 no other unacceptable -- where did she
4 go. Like at the Academy Awards, where
5 are they.

6 So that's why we only
7 (inaudible) and Mindy identified that
8 lead was only the only contaminant in
9 sediments and soils in Margaret's
10 Creek that were associated with
11 unacceptable risk.

12 So we looked at a whole bunch
13 of metals. We looked at a whole bunch
14 of contaminants, but lead was really
15 the only chemical that was driving the
16 action, so that is the only chemical
17 we have a plan for in soils and in
18 sediments.

19 The other thing that you asked
20 about is why is there no monitoring
21 associated with this remedy.

22 And in the proposed plan on
23 Page 11, let me get my Duane Reade
24 readers here. Under Common Elements,
25 that second paragraph, it says that

1 Proceedings

2 long-term monitoring is proposed to
3 assess impacts from remedial
4 activities for surface water and also
5 for groundwater and we will be
6 developing monitoring requirements for
7 surface water and groundwater when we
8 move into the next phase which had we
9 had the slide up there you would have
10 seen it which is the remedial design.

11 So there will be monitoring of
12 surface water and ground water as part
13 of our preferred remedy, but also part
14 of any remedy that we would have
15 there.

16 Keep in mind that because of
17 this remedy is kind of a walk away
18 remedy, once we implement it we're
19 gone. There will be no need for
20 ongoing monitoring once all of the
21 remedial action objectives and the
22 remedial goals that Tanya went through
23 and are presented in the proposed
24 plan, once those are achieved and we
25 will be monitoring groundwater and

1 Proceedings

2 surface water to insure that we do
3 achieve them.

4 There is no more need for
5 anymore monitoring. These levels that
6 we are trying to achieve are walk away
7 levels.

8 MS. MANBURG: Okay. The las
9 one was about the replacement of
10 wetland soils in the Margaret Creek
11 area.

12 MS. PENSAK: There weren't any
13 sediments contaminants of concern
14 within the Margaret's Creek area, so
15 we should not be touching any of the
16 sediments within wetland area.

17 The concern of course is that
18 when we go in to remove the the
19 battery and slag we're going in our
20 design reports, which I'm sure you're
21 going to have the opportunity to look
22 at, we're going to do what we can to
23 prevent any silt or any runoff into
24 those wetland areas.

25 We would like to restore the

1 Proceedings

2 habitat. We're not going to leave
3 huge gaping holes or anything like
4 that, so there may be some upland
5 plantings, but there doesn't need to
6 be any wetland restoration, mitigation
7 within that area.

8 There may also be some wetland
9 habitat restoration within the seawall
10 sector because we do have those
11 wetland plants growing there. So we
12 will look to replace them.

13 MS. MANBURG: Thank you.

14 MS. SEPPI: Thank you, Sam.

15 Next question or comment. Rich.

16 MR. CHAPIN: My name is Rich
17 Chapin, C-H-A-P-I-N. As Bob said, I'm
18 a technical consultant to the Edison
19 Wetlands Association as well as a
20 member of (inaudible).

21 I'm a licensed professional
22 engineer. I have been doing
23 environmental engineering for 45
24 years. I have been around the board I
25 guess on this thing. I have prepared

1 Proceedings

2 some comments. These are drafts.
3 Will probably embellish on these after
4 I get a little bit further to dig into
5 what we are doing.

6 My first comment is to say
7 thank you to the EPA for selecting the
8 right remedy, the right remedy for the
9 people here and the right remedy for
10 the bay because at the end of day the
11 ocean, any containment on-site the
12 ocean would always win.

13 It doesn't matter how we
14 engineers might design a solution and
15 estimate its lifetime and it may be my
16 grandchildren or their grandchildren,
17 the ocean would win. So someone would
18 be coming back to address the issue in
19 the future, so thank you.

20 I'm not -- Bob promised I
21 wasn't going to nitpick, but I don't
22 know if it's true. Some of these
23 questions are some detailed things
24 that I would like the EPA to look at.
25 Just a few comments.

1 Proceedings

2 There's talk about
3 institutional controls for remedies.
4 There are places where it says that
5 this remedy will have no institutional
6 controls.

7 It wasn't really clear to me,
8 so just more explicit statements in
9 the ROD of what is going to be,
10 please. As we said lead is the
11 driving force for contaminant cleanup
12 here. In general you'll find that at
13 any complex site. You can usually
14 boil it down to one or two things that
15 no matter what you do these things
16 control. Lead controls here.

17 And I understand having a
18 joint sediment and soil issue. You
19 don't want one to recontaminate. You
20 don't want to clean up the bay to less
21 than the soil, then have the soil
22 erode back in and recontaminate the
23 bay or vice versa. I understand that.

24 I do have a little bit of
25 issue though with the 400 PPM human

1 Proceedings

2 health number. As we in the business
3 know that's based on a long-term
4 number that came out of the IUPAC
5 model on -- to protect a child from
6 greater than ten decaliter -- 10
7 micrograms per decaliter of blood, is
8 that --

9 MS. SMITH: Deciliter.

10 MR. CHAPIN: Deciliter. My
11 apology. Again there is lots of
12 discussion these days how there is no
13 safe level of lead for children and
14 there's lots of discussion about
15 possibly revising that number.

16 And so I would ask the EPA and
17 the ROD to take a real hard look at
18 400. I understand the economics
19 difference between 200 and 400, for
20 example, and I understand Samantha's
21 problem about larger volumes moving
22 out, but if we clean up, we're
23 selecting a remedy today at 400, but
24 we know that the state of the art is
25 going to change in the near future and

1 Proceedings

2 the number actually should be 200,
3 what have we accomplished.

4 And given the magnitude of the
5 dollars we are talking about, these
6 are big dollars, I think it's in
7 everybody's best interest to have a
8 harder look at the number.

9 If 400 turns out to be the
10 magic number, so be it. If it's a
11 hundred which many state agencies that
12 have numbers that are less than the
13 400 and their risk assessors have a
14 different opinion than other risk
15 assessors. I understand all of that.

16 I just think that it's
17 important if we are going to do it
18 let's try and do it only once and then
19 be done with it and then you can have
20 that beautiful beach back. Thank you.

21 (Applause.)

22 MS. SEPPI: Yes, sir. Just
23 one second. I think they wanted to
24 respond to Rich's comment.

25 MR. SIVAK: I just wanted to

1 Proceedings

2 touch upon a couple things that you
3 said although I didn't take good notes
4 on it, so I apologize.

5 Okay. So you mentioned the
6 cleanup goal that we have of 400 parts
7 per million. Right now that is EPA's
8 current policy to clean up lead sites
9 to 400 parts per million of lead in
10 soil. Our cleanup plan was reviewed
11 by our headquarters in Washington,
12 D.C. and it was found to be an
13 appropriate and protective cleanup
14 goal for this site as well as for
15 other sites around the country.

16 So I do want everybody in the
17 room to understand that the cleanup
18 goal that we have selected and the
19 remedy we have selected that will
20 achieve that cleanup goal is a remedy
21 that is protective for children in
22 this room, for children at this site
23 and children in this room as well.

24 EPA is always reviewing
25 toxicity information on every chemical

1 Proceedings

2 that is out there, absolutely. Not
3 only -- not only information that EPA
4 develops through its own research and
5 development, but also through other
6 studies that are done in industry and
7 academia. We review all toxicological
8 information as it is made available to
9 the agency and when that review
10 indicates that a revision to the
11 toxicity guideline needs to be
12 completed we go back and we look at
13 it.

14 I think we have some great
15 examples of that that just happened
16 this year with dioxin and
17 trichloroethylene. We revised those
18 toxicity values we as an agency are
19 going back and looking at our
20 decisions.

21 So we are very comfortable
22 that the remedy that we have proposed
23 and the cleanup goals that we have
24 proposed are protective of the public
25 health and the environment at this

1 Proceedings

2 site.

3 When you mentioned a cleanup
4 goal of many other states that is
5 lower and I believe you mentioned 100,
6 if you look at how that number was
7 developed you will find that, at least
8 when I looked at the number from
9 Minnesota which I believe is the state
10 that you are referring to, I believe
11 that you will see that their ingestion
12 rate they used to come up with that
13 number is a significantly higher
14 ingestion rate than is EPA's typical
15 default ingestion rate.

16 MR. CHAPIN: Question. Who
17 knows how much dirt a child eats and
18 that's the number what we were
19 discussing.

20 MR. SIVAK: And the number
21 that EPA uses is a peer reviewed value
22 that has been used in Superfund sites
23 across the country and EPA believes it
24 is an appropriately protected number.

25 Other thing to keep in mind is

1 Proceedings

2 our cleanup goal is 400 which means we
3 are addressing contaminant
4 concentration that exceeds 400. That
5 doesn't mean that every concentration
6 that remains is 399. That residual
7 lead contamination is significantly
8 less than 400 because we're removing
9 those concentrations that exceed that.
10 If you look at the data that are in
11 the --

12 MR. CHAPIN: (Inaudible) 399
13 do you leave it in place.

14 MR. SIVAK: Correct. But we
15 also have lots of concentrations from
16 the RI that indicate we have
17 significantly lower concentrations as
18 well and we assume that exposure is
19 across an area. We look at that
20 exposure across the entire area. So
21 we do believe that our remedy is
22 protective.

23 MR. CHAPIN: I'm not saying
24 that it's not. I'm asking you to look
25 harder at the number in light of the

1 Proceedings

2 fact that there is lots of literature
3 out there that says that 10 number
4 that has been used as the basis for
5 cleanup of 400 is for a long time now
6 is too high and that children who have
7 that ten in their blood have been
8 affected negatively. That's all I am
9 saying, that you take a harder look at
10 it. That's all.

11 MS. SEPPI: Thank you, Rich.

12 MR. SYED: Tasweer Syed,
13 T-A-S-W-E-E-R, Syed, S-Y-E-D, and I'm
14 President of the Islamic Center of Old
15 Bridge. Good evening, everybody,
16 ladies and gentlemen. And as I have
17 said my name is Tasweer Syed. I'm the
18 President of the Islamic Center at Old
19 Bridge.

20 We are located right at the
21 southwest corner of the Area 9 which
22 is the Margaret's Creek and before I
23 go too much into it let me first
24 congratulate the EPA for a job well
25 done. Such a professional thing that

1 Proceedings

2 I rarely see in how projects have been
3 managed and the CAG which has been
4 very intimately involved.

5 We have a school. The Islamic
6 Center has a school which is a
7 full-time school attended by over a
8 hundred very young children,
9 elementary school and then we have a
10 Sunday school which has another
11 hundred students and we have other
12 activities and a lot of people visit
13 our center occasionally, sorry, every
14 day.

15 And I was asked if I would
16 join the CAG, but I refused, and I
17 said I will completely trust what the
18 decision have been made and the CAG is
19 like a large group of people which
20 includes a very diverse background. A
21 lot of them are professional and they
22 all mean well.

23 But the only thing we did ask
24 or I did ask was that you make a
25 decision, but once you make a decision

1 Proceedings

2 we have to stick with it, okay. And
3 the EPA will be the referee. I know
4 we like to get the moon and the stars
5 and everything, but I also come from
6 an industrial background. I've been
7 in the environmental area for 35
8 years. I have just retired from one
9 job and I got back as retired now
10 working as a consultant.

11 So, please, I have seen many
12 projects. I am not going to name my
13 company, but we have had many sites
14 that were contaminated and I know how
15 these sites can -- how these can go on
16 and how the projects can be delayed
17 further and further.

18 Do not let that happen. Let's
19 move on EPA. They have qualified
20 people there. If they have made a
21 decision to move on and they have
22 decided let's all support it. Let's
23 not have dissenting opinions now that
24 I'm finding that some of us are not in
25 complete agreement.

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2 So I think, CAG, you agreed
3 that you will be with one decision.
4 So don't come up with anything that
5 will set us back.

6 I have adopted this area and I
7 have been in America more than 36
8 years, but we came to what is called
9 the Clifford Beach section for the
10 past 11 years when we built our
11 community center and we have a lot of
12 people in the community and the
13 community at large has accepted us and
14 welcomed us with both open arms.

15 So we are very grateful to you
16 and happy that we have a very good
17 relationship amongst our community and
18 I would just ask to please let it go.
19 Let the EPA take over. Let's move
20 forward.

21 I have been there 11 years
22 hoping every day that somebody will
23 come and start cleaning up the site
24 and we can move on and we can enjoy
25 the nice beautiful views and sceneries

1 Proceedings

2 and whatever.

3 So let's not wait for our next
4 generation to come and enjoy these
5 things. Let us enjoy these before we
6 move on.

7 Thank you very much for
8 allowing me the time.

9 (Applause.)

10 MS. SEPPI: Thank you. I know
11 you're next, I wondered, Congressman
12 Pallone had another comment, if you
13 just don't mind.

14 CONGRESSMAN PALONE: She can
15 go first.

16 MS. SEPPI: Okay. Thank you.
17 That's very nice.

18 MS. SZAKIELO: My name is
19 Teresa Szakielo, S-Z-A-K-I-E-L-O. And
20 I just wanted to quickly comment on
21 the lead levels.

22 So you guys said 400 was what
23 your goal to REMOVE. So what happens
24 in five years after you guys leave and
25 then they decides it's 200. Are you

1 Proceedings

2 guys going to come back and fix it?

3 MR. SIVAK: There's a
4 multi-step process. There's a
5 multi-step process that the agency
6 goes through whenever we revise
7 toxicity values that requires us to go
8 back and look at remedies that are out
9 there.

10 One of the things that we
11 would look at in a site like this
12 potentially would be what are the
13 concentrations of lead that are left
14 behind. So as I said earlier, we are
15 removing above 400, but that doesn't
16 mean that everything below 400 is at
17 399. Some of the concentrations may
18 be as Rich appropriately pointed out.
19 Some of them are going to be
20 significantly lower than that.

21 When we look at exposure, and
22 I used to be a risk assessor so I have
23 done this on hundreds of sites, when
24 we look at exposure to any contaminant
25 we look at the area over which a child

1 Proceedings

2 would be or anyone would be exposed
3 and so that area can vary from a small
4 area like a yard which is a very
5 standard kind of exposure area to a
6 much larger area like a beach.

7 So we would look at all of
8 these areas and try to figure out --
9 that's one of the reasons why we kind
10 of partitioned the site the way we did
11 in these 11 areas. It's complicated
12 when you're standing up here and
13 you're saying Area 3 and Area 4 and
14 Area 2 and 6 and Area 5, but when
15 you're trying to figure out how people
16 might be exposed and how we can look
17 at the site in a more reasonable
18 manner that was a very appropriate way
19 to divide the site. And then we
20 didn't think about standing in front
21 of a roomful of people and talking
22 about Area 2 and Area 6 and Area 5 and
23 Area 8.

24 So if there is a change to the
25 toxicity value that doesn't

1 Proceedings

2 necessarily mean the remedy that we
3 implemented is no longer protective of
4 public health and the environment.
5 What that means is we have to go back
6 and look at what's left behind. We
7 have to look at what was there in the
8 first place.

9 There's a lot of other factors
10 that go into that.

11 MS. SZAKIELO: I just want to
12 know if you would fix it.

13 MR. SIVAK: If the toxicity
14 value changes or EPA's policy on how
15 we evaluate lead would change in the
16 future we would come back to see if
17 the remedy that we implemented was no
18 longer consider protective.

19 If it wasn't then we would
20 absolutely do what we needed to do to
21 make that remedy protective.

22 MS. SEPPI: Congressman. That
23 was a really good question. I was
24 thinking the same thing myself.

25 CONGRESSMAN PALONE: I just

1 Proceedings

2 have a question and I apologize, Pat.

3 MS. SEPPI: That's okay.

4 CONGRESSMAN PALONE: Because I
5 said I wouldn't get back up, but now
6 I'm back. And you may have already
7 covered this because I had to step out
8 and take a call.

9 But when you that say that
10 Alternative 2 is protective of human
11 health and we had some comments after
12 that too about impact on human health,
13 what is that based on. Do you do a
14 health assessment. What is that
15 agency, is that ATSDR, is that
16 involved, would you just comment on
17 that. Maybe the CAG people already
18 know the answer, but I don't know.

19 MR. SIVAK: So Congressman
20 Pallone asked about an agency, another
21 Federal agency called the Agency for
22 Toxic Substances and Disease Registry.
23 We call it ATSDR.

24 They're a division of the
25 Centers for Disease Control which is I

1 Proceedings

2 think an agency that most people know
3 a little bit better. They provide --
4 they're kind of a sister agency to EPA
5 in another department and they provide
6 some services that EPA does not. They
7 have physicians that we do not have.
8 They have medical professionals that
9 we do not have.

10 They can evaluate
11 biomonitoring data, blood lead
12 information. They can look at other
13 kinds of data, urine samples, if
14 that's necessary, hair samples, and
15 they can work with your physicians to
16 provide physicians with information
17 they might need to look at to help you
18 answer questions about environmental
19 exposures.

20 When a site is proposed to the
21 national priorities list the Superfund
22 law requires that ATSDR conduct what's
23 called a public health assessment at
24 the time of listing or within one year
25 of listing.

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2 And one of the purposes of
3 that public health assessment is to
4 identify are there any threats to
5 public health in the environment that
6 need to be addressed right now.

7 They also look at -- they also
8 try to replicate or try to piece
9 together what past exposures may have
10 been based on any information we might
11 have gathered about the site.

12 There is a public health
13 assessment available for this site.
14 It's in the repository I would
15 presume, yes. Has ATSDR been out
16 here?

17 MS. SEPPI: Yes, a couple
18 times with the CAG, yes. I just want
19 to mention that ATSDR based on their
20 health assessment is the reason, one
21 of the main reasons why we have the
22 Area 2, the closed beach fenced off as
23 well as we have placed a fence along
24 the seawall along this area here as
25 well. So that would based off of the

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2 ATSDR recommendations.

3 MR. SIVAK: Thank you. So
4 they were involved initially and they
5 continue to kind of monitor what's
6 going on out here. When there are
7 significant changes, say there is a
8 change in the lead toxicity as this
9 woman asked, they would look at lead
10 sites not only here, but around the
11 country and probably weigh in on how
12 EPA is responding to that.

13 So they haven't gone away, but
14 ATSDR also considers 400 parts per
15 million an acceptable lead level and
16 since they are a component of CDC
17 that's a conclusion that we take very
18 seriously, okay.

19 MS. SEPPI: Okay. Senator, I
20 know you're going to say get the lead
21 out; right.

22 SENATOR THOMPSON: I just
23 would like to say something in
24 response to the questions coming up
25 here related to my own experience.

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2 I mentioned before that years
3 ago I headed the childhood lead
4 poisoning testing program in the State
5 Health Department. I guess it was
6 about 25, 30 years ago that I first
7 came in to head that unit.

8 At that time the CDC stated
9 that the levels of concern were ten
10 micrograms per deciliter for children
11 in the blood. That was based upon the
12 best available information at that
13 time. That's various scientists and
14 health professionals that assess
15 children all around in looking for the
16 impacts and where it would come into
17 play.

18 Later further studies
19 indicated five micrograms per
20 deciliter could impact a child. When
21 they came up with that then the
22 children had been tested before were
23 retested and if they were found now to
24 have this level they were treated. So
25 it was show that even lower levels

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2 could impact mental abilities and et
3 cetera.

4 So based as new scientific
5 evidence comes along then what is done
6 is adjusted to take care of what
7 science says is needed. That's if at
8 some point they say 200 micrograms is
9 where you really should be, then the
10 EPA will adjust and take care of it,
11 but today the best available
12 information says 400 parts per million
13 is the level we have to be concerned
14 with.

15 And I'm sure that if in the
16 future the scientific data and studies
17 come along to suggest it should be
18 lower because they came along and said
19 it was 200 somebody will go out here
20 and check they level and say hey, it's
21 250 here. Then there will be an
22 effort to go cure that, but I mean
23 science of course is a continuously
24 developing process and as new
25 information comes along and dictates a

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2 need then things will be adjusted and
3 cared for. Thank you.

4 MS. SEPPI: Thank you. I
5 think we probably exhausted all the
6 lead questions. Does anybody have a
7 comment about something else. Bill.

8 MR. SCHULTZ: Bill Schultz,
9 S-C-H-U-L-T-Z. I'm the Raritan
10 Riverkeeper.

11 Not to belabor the point
12 everybody says yeah, yeah the EPA has
13 really been involved in several sites
14 and to get to this point it wouldn't
15 be unusual to be like ten years, 12
16 years to get to this point and I think
17 we are here in I think about three or
18 four.

19 I see Gregg Remaud, my parent
20 organization here, New Jersey
21 Baykeeper. Greg can attest to what 50
22 years working on sites before we get
23 to this point, something like that.
24 So this has really moved.

25 Your representatives in

1 Proceedings

2 Washington have really pushed the EPA
3 and really spurred this on. They need
4 to be deserving of some recognition.

5 (Applause.)

6 MR. SCHULTZ: You have a group
7 of community people here that came
8 together for this, CAG. We keep
9 hearing the term CAG and I have been
10 on this CAG for I guess about three
11 years.

12 An amazing group of your
13 citizens came together and formed a
14 committee, waded through volumes and
15 volumes of scientific data that the
16 EPA has provided us with and
17 interpreted it and got it down to
18 where the common citizen can
19 understand it and I think that is an
20 outstanding group of people that your
21 communities have developed and that is
22 a group that really deserves a round
23 of applause.

24 (Applause.)

25 MR. SCHULTZ: That being said,

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2 I have a question for EPA. Now this
3 goes to public comment and I am in
4 favor of Alternative 2. Get that on
5 the record first thing.

6 Now, I'm sure somebody is
7 going to come back, some unnamed
8 industry at this point will come back
9 and say they don't approve, they're
10 not in agreement with Alternative 2.

11 You have got a bunch of people
12 that say they are. Is it a question
13 of numbers or does it come down to
14 statistics. What pulls the weight.
15 Does everybody in the room have to
16 send a letter or make a comment that
17 they are in favor of Alternative 2 or
18 does one industry get up and say we
19 don't like it and that reverses
20 everything?

21 MS. SEPPI: I mean I can
22 answer that, too. It's a good
23 question. It's not a contest. It's
24 not a contest at all like who gets the
25 most comments or anything like that.

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2 The proposed plan is the way EPA would
3 like to see the site cleaned up. We
4 think that that's the best
5 alternative.

6 If we get comments from
7 industries who do not agree with us
8 that's fine. That's the purpose of
9 this comment period. We will look at
10 those comments. We will take them to
11 heart, we'll study them, we'll take
12 them seriously.

13 If we find something in those
14 comments that we think is relevant
15 that should be applied in this
16 situation we'll certainly give it
17 weight.

18 But, you know, having the
19 majority of people that are here
20 tonight agree with the alternative
21 that also adds a lot of weight. So at
22 this point we really can't say that
23 anything is going to change. We'll
24 have to wait until we get all the
25 comments in, until Tanya responds to

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2 all those comments in the
3 responsiveness summary which will be a
4 part of the Record of Decision.

5 Everything that is said here
6 tonight, the comments and questions
7 will be a part of that and then we
8 will issue our Record of Decision and
9 as I said that will be our final
10 decision.

11 MR. SCHULTZ: Thank you.

12 MS. SEPPI: Do you want to add
13 anything else?

14 MR. SCHULTZ: No.

15 MS. SEPPI: Thank you, Bill.
16 George.

17 MR. MILLETT: Good evening.
18 My name is George Millett,
19 M-I-L-L-E-T-T. I am a member of the
20 CAG and I approve this plan that's
21 being proposed.

22 I wanted to highlight one
23 feature we've been doing and that is
24 we do have a website which is
25 www.raritanbayslag.org.

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2 MS. MANBURG: Yes.

3 MR. MILLETT: Yes. And we
4 have a Facebook page, too, Raritan Bay
5 Slag.

6 MS. MANBURG: CAG.

7 MR. MILLETT: CAG. And
8 Samantha here and Karl have been
9 working on that for about a year and a
10 half now and it's a good source of
11 information if we can remember those
12 things.

13 I also want to propose to CAG
14 that we add to this website something
15 that promotes the idea that
16 Congressman Pallone suggested, and
17 that is passage of what the
18 Congressman has called the Polluter
19 Pays Act.

20 In its present form it's
21 asking for only .00265 cents per
22 hundred dollars of tax revenue.
23 That's as if you have to pay \$2.65 for
24 a \$10,000 assessment on your house.
25 It's a very, very small amount of

1 Proceedings

2 money. The idea --

3 (Applause.)

4 MR. MILLETT: The idea is this
5 money should be collected from the
6 people who produce these materials
7 that have to be disposed of. Not from
8 the taxpayer.

9 There was a fund that was
10 surplus open in 1982 that eventually
11 reached about \$370 million, but it
12 expired in 19 -- in 2003. All the
13 money was used up by then and
14 Congressman Pallone and other
15 Congressmen have been trying to get
16 that fund revised.

17 So we are going to try to put
18 a Facebook page I hope, if they agree
19 to do the work you will be able to
20 access that and tell your friends on
21 Facebook about it and maybe they can
22 get this idea spread all around the
23 country. Thank you.

24 (Applause.)

25 MR. MILLETT: The EPA endorses

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2 this idea and Director Jackson even
3 put out a news statement back in April
4 I think of 2011 promoting it. So it's
5 not some radical plan coming out of
6 somebody's mind. This is a well
7 thought out plan.

8 MS. SEPPI: Thank you, George.

9 Karl, you have a question.

10 MR. HARTKOPF: Yes. Comment.

11 MS. SEPPI: Comment.

12 MR. HARTKOPF: Karl Hartkopf;
13 K-A-R-L, H-A-R-T-K-O-P-F.

14 And I guess the first thing I
15 want to say is thank you to EPA.
16 Night meetings are a bitch and you
17 guys have to do them all the time, so
18 hats off to you guys.

19 I've been telling the members,
20 I'm also a member of the CAG, I've
21 telling them that I am cautiously
22 ecstatic at this solution. Ecstatic
23 clearly because they're going to take
24 it away, cautiously because, you know,
25 some of the minor nitpicking you have

1 Proceedings

2 been hearing here all night. For
3 example, it's a cleanup and disappear
4 kind of plan.

5 I'm a little concerned about
6 that because even they have said it's
7 a dynamic site where there's a lot
8 going on. It's continually breaking
9 up in the surf. Even if they remove
10 all the kettle bottoms we don't know
11 what the long shore current is going
12 to be doing on the site, you know,
13 over the next one, five, ten years.
14 What it will uncover, what it will put
15 during hurricanes. The flow does
16 change during Noreasters, et cetera.

17 So I would sort of encourage
18 them to add monitoring. I mean I'll
19 probably submit written comments to
20 that effect as well. And also just
21 keeping the eye out for hidden
22 contamination that they hadn't found
23 on the site, maybe just adjacent to
24 the site. I want to encourage them to
25 do whatever they can do to not exclude

1 Proceedings

2 something if they find it one foot
3 outside the site.

4 And, finally, there are a lot
5 of other sites in Raritan Bay and we
6 have had the help of New Jersey, New
7 York Baykeeper and Riverkeeper, Edison
8 Wetlands Association, and they've been
9 supporting us.

10 I sort of want to throw out
11 there that maybe you should be
12 supporting them. They will continue
13 to help support cleanup sites
14 throughout the bay in Sayreville,
15 adjacent towns. The bay water will
16 get cleaner every time we clean up one
17 of these sites and the fish advisory
18 which has been in place for 16 years,
19 some day they may be lifted if we
20 continue to clean sites up. So, you
21 know, your stripers will be cleaner
22 every year as they continue to do this
23 work and any politicians that support
24 work like this as well support them
25 back. So thank you.

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2 (Applause.)

3 MS. SEPPI: Thank you, Karl.

4 MS. SCHIPPER: Roberta

5 Schipper, S-C-H-I-P-P-E-R.

6 I think I already know the
7 answer, but I want to know what
8 happens since we're talking about how
9 quickly this is moving which is great,
10 but the responsible party if they
11 don't like the solution what happens
12 to the speed. Does it get shut down,
13 does the EPA go ahead and try to
14 collect the money later, does it come
15 to a stop?

16 MS. SEPPI: That's a good
17 question.

18 MR. SIVAK: They're all good
19 questions.

20 MS. SEPPI: They're are all
21 good questions.

22 MR. SIVAK: But that is a good
23 question. So the next step in the
24 process, and again this kind of goes
25 back to that great little slide you

1 Proceedings

2 all might remember having seen earlier
3 tonight with stepping stones.

4 Once we get through the public
5 comment period which again has been
6 extended through November 27th, EPA
7 will issue a Record of Decision that
8 memorializes our final remedy for the
9 site. Then we begin what's called a
10 remedial design. We're going to
11 design and identify all the specifics
12 of all the components to this remedy
13 that Tanya went through with you
14 tonight.

15 Before we can do that, though,
16 we have to negotiate or we have to sit
17 down and start talking with the
18 responsible party about asking them to
19 participate in that remedial design
20 process.

21 And as of now we have had no
22 indication from the responsible party
23 that they're not willing to sit down
24 with us in good faith and enter into
25 those negotiations. So that's how we

1 Proceedings

2 will proceed.

3 If that ultimately doesn't
4 happen, and on other sites where we
5 don't have a responsible party then,
6 yes, we would initiate the work, but
7 we have to start by sitting down with
8 the responsible party and entering
9 into those negotiations to move into
10 that next step.

11 MS. SCHIPPER: Can that legal
12 end of it go like, really get in the
13 way of getting it started.

14 MR. SIVAK: We have to -- we
15 have to go -- we have to sit down to
16 the responsible party and initiate
17 that conversation about moving forward
18 with the design.

19 As I said, we've had no
20 indication that they are not
21 interested in sitting down with us.
22 So we have to go through that process
23 until we reach a point where we
24 either, yes, we will move forward or,
25 no, we're not going to be moving

1 Proceedings

2 forward. So yes, there is going to be
3 a negotiation process before we move
4 into the actual physical design step
5 of the process.

6 MS. SEPPI: The gentleman in
7 the back, a question. Yes. Sorry, I
8 don't know your name.

9 MR. GIBSON: I have taken
10 about a thousand depositions in my
11 life.

12 (Discussion off the record.)

13 MR. GIBSON: Good evening. My
14 name is Chris Gibson and I represent
15 NL Industries.

16 I want to start off just by
17 simply stating that I know that in the
18 past when I have come to CAG meetings
19 some things that I have said and
20 probably some things that I will say
21 tonight have not always been the most
22 popular, but I do want to thank EPA
23 and I want to thank the CAG and I want
24 to thank the citizens of Old Bridge
25 for at least listening. They've done

1 Proceedings

2 it with courtesy. They've done with
3 respect and politeness and it is a
4 pleasure in today's world to see that
5 civility can still be part of civil
6 discourse.

7 I have represented NL for the
8 better part of 15 years now. I can
9 tell you that while it's always easy
10 to demonize any party, the reality is
11 that NL and Region 2 and throughout
12 the country has spent millions and
13 millions and millions of dollars
14 performing environmental cleanups
15 oftentimes of lead.

16 The simple truth is that NL
17 has always taken its environmental
18 responsibilities seriously and that is
19 why I think at this point, Mr. Mayor,
20 we have probably worked with I think
21 or tried to work with three different
22 administrations to talk about creative
23 solutions to take care of this problem
24 that would effectuate three goals.
25 One, that it was quickly implementable

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2 and could be implemented and for some
3 of the CAG members you'll remember
4 that we sat there and talked about it,
5 a remedy that did have the on-site
6 encapsulation component that we
7 believe if we could have been out in
8 the field this summer coming up and
9 have the thing completed.

10 The next goal is the same goal
11 as EPA, that anything that happened
12 would be fully protective of the
13 public health and the environment.

14 And the third goal is cost
15 effective and I'm going to get to that
16 point in a little bit more detail in a
17 moment, but when people hear it what
18 they say is NL or any other person is
19 trying to avoid its responsibility or
20 do something on the cheap.

21 Cost effectiveness under the
22 Superfund law is a requirement. We
23 didn't just meet with Old Bridge. We
24 have met with EPA. We have met with
25 DEP to talk about implementing this

1 Proceedings

2 remedy that would have an on-site
3 encapsulation component.

4 Why have we done that. The
5 simple truth is, is that our belief
6 has been and remains that on-site
7 encapsulation is as protective of the
8 public health and as protective of the
9 environment, that these types of
10 encapsulations are utilized across the
11 country from sea to shining sea and
12 have been done so effectively.

13 And I know you can say that
14 the ocean always wins or the desert
15 always wins or that nature always
16 wins, but the simple truth is that all
17 of these types of encapsulations
18 whether they are off-site someplace
19 else or on-site can be done and can be
20 done effectively.

21 Where we part company with
22 EPA's remedy selection, and before I
23 get into that I knew coming here
24 tonight that when I saw EPA's remedy
25 selection I was going to be the only

1 Proceedings

2 one who wasn't happy with what
3 happens.

4 All right. And the reason for
5 that is I get it. I mean why wouldn't
6 you want everything taken off, taken
7 away. The simple truth is in
8 community after community across the
9 country everybody wants this stuff if
10 it ends up in their community taken
11 away. It's what we call an acronym
12 NIMB. Nobody wants it, not in my
13 backyard.

14 So I understand why everybody
15 is so supportive of the remedy that
16 EPA selected. I heard Mr. -- but we
17 will object and we will of course go
18 through the process.

19 And, Michael, when have I ever
20 not agreed to sit down and talk to you
21 if that's what you want, but we will
22 object to this remedy because we
23 believe that EPA in the feasibility
24 study, in the revised feasibility
25 study has basically concluded that

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2 on-site encapsulation and off-site
3 encapsulation are equally protective
4 and when that occurs they are both
5 short-term and long-term
6 implementable, and when that happens
7 what we believe the law says is that
8 the tie breaker goes to cost and that
9 you have to -- you have to, you must
10 select the most cost effective remedy
11 available.

12 And the most cost effective
13 remedy is to put the material in a
14 secure area in the upland. It can be
15 engineered so that there isn't
16 flooding. It isn't going to be a
17 mound. It is something that has been
18 done and has occurred at site after
19 site. It is effective and it is safe.

20 And so when you take one
21 option which is to spend \$30 million
22 more to take the material to
23 Pittsburgh or some place like that and
24 you have an equally protective option
25 of leaving it in place, we believe you

1 Proceedings

2 can't select the remedial alternative
3 that costs \$30 million more.

4 And that's why we will be
5 objecting to the remedial action that
6 has been proposed by EPA and we will
7 be providing our comments and, no, it
8 isn't a matter of who says the most as
9 was pointed out.

10 If that were the case, in my
11 particular profession I'm paid by the
12 word, I am paid by the hour, so I can
13 blab forever if that would actually
14 help and get this where we would win
15 it.

16 There's one other thing that I
17 just want to point out without trying
18 to cause any fight. When Mike was
19 talking about the history, he started
20 at about 1969 and jumped to 2007 as if
21 nothing occurred in between.

22 The reality is that this
23 material didn't just end up here. It
24 wasn't just placed here. There is a
25 historical shared responsibility for

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2 what happened out there.

3 This thing -- this material
4 didn't just magically become a
5 seawall. A developer worked with the
6 township at that time known as Madison
7 Township maybe before a lot of you
8 were here or cared. Some of you
9 before you were even born.

10 There was discussions. The
11 state was involved. Environmental
12 Commissions noted that this was
13 potentially problematic and what was
14 constructed was something called a
15 slag seawall. You didn't have to do a
16 slag seawall. You could have done
17 riprap. You could have done big
18 rocks. You could have done dunes.
19 There's all kinds of options that
20 could have been selected.

21 The predecessor to DEP was
22 involved. The State of New Jersey,
23 people knew what was in that seawall.
24 It was left in place and as far as
25 acting as a seawall my assumption has

1 Proceedings

2 been that it's been fairly effective
3 for that purpose.

4 My guess, I don't know for a
5 fact, is that it was selected rather
6 than paying for rocks or anything else
7 because it was cheap. But this
8 historical legacy problem is not just
9 NL's alone.

10 And so when we talk about
11 adding another \$30 million to a remedy
12 as if there is only going to be one
13 party, some amorphous taxpayer or NL
14 that is going to be responsible,
15 that's not the case.

16 I don't know where -- I don't
17 have a better crystal ball than any of
18 you, but I can tell you that as a
19 publicly traded corporation if we
20 think that what has happened is not
21 consistent with the law we simply
22 cannot come in and say, okay, we'll
23 spend another \$30 million to do
24 something that we don't think adds any
25 real protection to the environment or

1 Proceedings

2 the public health although I
3 understand it is wildly popular and I
4 understand the reasons why.

5 So I really just wanted to
6 come in here today and tell you what
7 NL's position at least preliminarily
8 is and where we are heading and we
9 will be going through the comment
10 period just like all of you and we'll
11 go through the process just as we have
12 at hundreds of sites here and
13 elsewhere, but I didn't -- I wanted
14 you to hear it from us.

15 I wanted you to hear it from
16 us because we have been to your
17 meetings. I wanted you to hear it
18 from us because we have sat down with
19 the public officials. I wanted you to
20 hear it that we are going to object to
21 this remedial action that we believe
22 is 30, \$40 million more expensive than
23 needs to.

24 I don't believe that by the
25 time the remedial design is done that

1 Proceedings

2 anybody is going to remotely put a
3 shovel in the ground until two years.

4 This is going to be a process
5 that is going to go on forever. NL
6 remains willing to still do what we
7 have been talking about all along. We
8 believe that we can get it done
9 quickly. We know we can get it done
10 quickly. We know we can get it done
11 effectively and we know we can get it
12 done in a way that is protective.

13 I know you're skeptical. I
14 know you think that's not true. But
15 you don't get the gold standard. In
16 fact, you have to pick the one that's
17 less expensive.

18 MS. MANBURG: Which is your
19 preferred alternative?

20 MR. GIBSON: What's my
21 preferred alternative -- which one is
22 it?

23 MS. MANBURG: Well, I don't
24 know. Four and five is pretty close.

25 MR. GIBSON: It's either four

1 Proceedings

2 or five. It's the ones that have the
3 on-site encapsulation aspect, that the
4 slag will be taken off and put
5 on-site.

6 MS. SEPPI: We have to take
7 turns asking questions.

8 MR. GIBSON: Thanks, Pat. I
9 appreciate it.

10 MS. SEPPI: You're welcome.

11 (A short recess was taken at
12 this time.)

13 (The proceedings resumed.)

14 MS. SEPPI: Okay. I have
15 Gregg and then Dana and we will see
16 who else hasn't asked a question or
17 given a comment yet.

18 MR. REMAUD: Thanks, Pat.

19 Hi. I'm Gregg Repaud,
20 R-E-M-A-U-D, Deputy Director of New
21 York/New Jersey Baykeeper and proud
22 member of the Raritan CAG.

23 On this 40th anniversary of
24 the Clean Water Act I'm very glad to
25 strongly support the EPA's recommended

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2 Alternative 2 which is the off-site
3 disposal of contaminates and the
4 contaminated soil and the lead slag
5 site.

6 Without spending too much time
7 obviously the residents of Old Bridge
8 and the environment of Sayreville have
9 gone through a lot both with their
10 environment, the community, property
11 values. We've heard it time and time
12 again. It's great that people
13 recognize the incredible work of the
14 individuals of CAG, the selflessness,
15 the hours of going through these
16 documents, of being there night after
17 night and spending hours, is something
18 to be very proud of, and they have
19 done a phenomenal job.

20 The simple truth with National
21 Lead is that they proposed a remedy
22 that was to collect contaminants and
23 take it and put it in Margaret's Creek
24 and cap it and not even spend the
25 money to have a liner to collect the

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2 seepage. That's the simple truth of
3 what National Lead's proposal was.

4 The simple truth is when you
5 have a landfill in people's backyards
6 their properties go down.

7 The simple truth is that there
8 is a chance of increased flooding
9 because now you don't have the area,
10 if there's a big area there to absorb
11 the flood waters which hurts the town.

12 So the simple truth is that
13 EPA has proposed right remedy for the
14 right reasons based on science, not
15 their bottom line.

16 I recommend folks go to the
17 website and look at Rescuing Raritan,
18 which gives a history of not only the
19 Raritan River, but National Lead
20 Company. The simple truth is they
21 spent a lot of money to bring in a lot
22 of attorneys and a lot of consultants
23 to try to slow down the process and
24 make you go with their proposed
25 alternative rather than the best

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2 alternative for the community. We've
3 heard it here tonight.

4 With that said, EPA knew
5 better, Old Bridge officials knew
6 better and CAG knew better and we're
7 continually to strongly support the
8 off-site disposal alternative.

9 We want to thank EPA, Pat,
10 Tanya, the whole team has been
11 phenomenal throughout this process.
12 Senator Thompson for his great quote,
13 get the lead out. Congressman Pallone
14 for his long standing support of
15 Superfund cleanups, polluter pays
16 legislation. Again the CAG, our
17 colleagues Edison Wetlands, Dana, Bob,
18 Rich who provide invaluable technical
19 assistance and their experience.

20 And Baykeeper has been proud
21 to work with the residents of Old
22 Bridge to preserve. We worked for ten
23 years trying to preserve that
24 Margaret's Creek area and we're going
25 to continue to work with folks. It's

1 Proceedings

2 a amenity. It's a flood control area.

3 We know who the responsible party is.

4 We're all reasonable folks.

5 We all base this on science and we

6 look forward to continuing working on

7 CAG with the great residents of Old

8 Bridge and Sayreville and with the

9 elected officials and EPA. Thank you.

10 MS. SEPPI: Thank you.

11 MS. PATTERSON: Hi. My name

12 is Dana Patterson, P-A-T-T-E-R-S-O-N,

13 and I'm the program supervisor for the

14 Edison Wetlands Association.

15 I've been involved with the

16 Raritan Bay slag site and I've been a

17 member of the CAG for over three years

18 and I have to say that CAG, I am very

19 proud of them. I serve on a lot of

20 different CAG's throughout the state,

21 on other Superfund sites and by far

22 this CAG has done a tremendous job and

23 you should all give yourselves a round

24 of applause for doing so.

25 And I have to say it was not

1 Proceedings

2 an easy process. We did have our ups
3 and downs over the last three years,
4 but we came to a very great decision.

5 I would like to thank EPA, you
6 guys have been a very big help for
7 this community. You have always been
8 there. You have always answered our
9 questions. And two individuals that
10 are not here tonight from EPA are Joe
11 Rotola and Andy Confortini. They were
12 there from the beginning of the
13 process and they provided residents
14 with weekly updates on what was going
15 on in the community when they
16 installed the fence and took all kinds
17 of protective measures and because of
18 them and because of their efforts and
19 advocacy within the EPA that's why
20 this process has gone so quickly.

21 They are all from the remedial
22 branch. Tanya is from the remedial
23 branch so they worked together and
24 because of EPA working together we are
25 here today three years with a proposed

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2 plan. Many sites take 20. So
3 everyone should be thankful for that.

4 I'd also like to Senator
5 Menendez and Congressman Pallone for
6 their statements. It's really
7 important to have them attend the
8 community meetings and have the
9 community hear what they have to say
10 and the other elected officials who
11 also came out this evening.

12 Back three years ago when we
13 had one of the first public meetings
14 Sharon Kubiack from the New Jersey
15 Department of Health and Human
16 Services stood up in front of everyone
17 and she said and I quote, there is no
18 safe level of lead. And I think that
19 EPA needs to take that into
20 consideration with this plan.

21 There has been a lot of
22 questions today about lead and the
23 level that's used and Rich Chapin
24 brought up some very good points about
25 using the 400 number. I think that

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2 EPA needs to take that into
3 consideration, especially with the
4 fact that that level may change, the
5 level for ten in children's blood may
6 go down.

7 So we need to think future
8 here. We don't want to come back and
9 do this again like we did in Ringwood.
10 We want to get it done now. So EPA
11 needs to take that into consideration.

12 Also, the next step here is
13 accelerating this cleaning up. The
14 Record of Decision could take a year.
15 The remedial design could take another
16 year. We're looking at three years
17 before we even have a shovel in the
18 ground.

19 So I think EPA has done a
20 great job so far speeding this thing
21 up, but we need to push them as
22 community and hold them accountable
23 and try to get the remedial design and
24 Record of Decision in less than three
25 years. They can do it in one year.

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2 We can have a shovel in the ground by
3 next year. So I encourage everyone
4 when you submit your public comment to
5 also encourage EPA to speed up the
6 cleanup.

7 I just want to address a few
8 things. I think it's really the
9 community should be really taken back
10 by the fact that someone would come up
11 here and say that it's okay to create
12 a new landfill in your backyards, in
13 your wetlands, in your flood zone.

14 I think that that's absurd.
15 Why would you want to create a brand
16 new landfill right next to your homes,
17 right next to the Islamic school when
18 there is a certified hazardous waste
19 landfill where this material can go
20 and be accepted and is regulated. You
21 don't want that in your backyard.

22 So I think EPA is making the
23 right decision here. They understand
24 the community's concern. Over the
25 last two years they have listened to

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2 the community's concern and they have
3 taken that into account by selecting
4 Remedy 2.

5 The main thing is that
6 Alternative 2 will offer, this is
7 biggest, biggest difference between
8 the other remedies, alternatives and
9 Remedy 2. It is a permanent solution
10 to this problem. Permanent solution
11 to this problem.

12 And everyone needs to realize
13 that and I think many of you do, but
14 we don't want ongoing monitoring for
15 the next 30, hundred years, forever.
16 We want it removed out of our
17 community and have our beach back. A
18 permanent solution to get your beach
19 back. Thank you.

20 (Applause.)

21 MS. SEPPI: Is there anybody
22 else who has a comment who hasn't
23 spoken yet and then we'll go around
24 Round 2.

25 Paulette.

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2 MS. MAYERS: My name is
3 Paulette; P-A-U-L-E-T-T-E, Mayers,
4 M-A-Y-E-R-S.

5 I had no intention of coming
6 here and talking tonight. I had
7 already typed up my comments. It's
8 been in Tanya's hands for a couple of
9 weeks already, but after a gentleman
10 stood up here and said we go by the
11 price and that's what's going to
12 decide it and it should be
13 encapsulated in the wetlands behind my
14 house.

15 I listened to him just like I
16 listened to him the first time he came
17 and stood before the CAG and gave his
18 remedy for cleaning it up. It was
19 going to be quick. It was a candy
20 apple waved in front of everybody
21 there. I'll start, we'll have it done
22 in a year. We all that knew was
23 untrue.

24 He went on and on for hours
25 that night. I rebutted him on many

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2 occasions during that meeting and his
3 final statement to me at the end of
4 the meeting was, he looked me right in
5 the eye and he said somebody is going
6 to go home unhappy.

7 Well, tonight someone is going
8 to go home unhappy.

9 (Applause.)

10 MS. MAYERS: And I do support
11 Alternative 2.

12 MS. SEPPI: Thank you,
13 Paulette.

14 Anybody else who hasn't had an
15 opportunity.

16 Mayor.

17 MAYOR HENRY: Thank you again
18 everyone. Mayor Owen Henry,
19 H-E-N-R-Y.

20 Two comments. I just want --
21 I was remiss before. I didn't
22 recognize some Council people that
23 were in the audience. I saw
24 Councilman Volkert. Is he still here.
25 Bob, thanks for coming, Ward 1. Three

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2 Council at large, I saw Councilman
3 Anderson, Councilman Cahill,
4 Councilman Walker. They are
5 responsible for this also, Ward 1
6 throughout the town and Ward 6,
7 Council person Lucille Panos is also
8 here.

9 The town is very concerned of
10 what's going to happen on this site.
11 I had some questions. I don't know if
12 they were answered. I wasn't paying
13 attention, not that I wasn't paying
14 attention.

15 Your Record of Decision date,
16 when do you think you will make your
17 Record of Decision?

18 MS. SEPPI: We don't have a
19 date for that yet.

20 MAYOR HENRY: Average.

21 MR. SIVAK: I would say early
22 next year, early 2013. Early 2013.

23 MAYOR HENRY: And I ask these
24 questions, as a Mayor we need to be
25 ready for what's the next -- we want

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2 to be proactive. You're saying early
3 2013.

4 MR. SIVAK: Early spring 2013.

5 MAYOR HENRY: 13, the Record
6 of Decision will be --

7 MR. SIVAK: It will be signed
8 and will be final.

9 MS. SEPPI: And that will go
10 out for everybody to see.

11 MAYOR HENRY: And I'm assuming
12 the money, the funding is in place for
13 you to make that decision. You are
14 funded through 2013?

15 MR. SIVAK: We are funded
16 through making the -- signing the
17 Record of Decision.

18 MAYOR HENRY: That leads up to
19 my next question. The next one was
20 the remedial design.

21 Am I to assume, and I think
22 that phase is not funded yet.
23 Washington is here. Well, they were
24 here. That phase is not funded yet,
25 is that accurate, an accurate

1 Proceedings

2 statement?

3 MR. SIVAK: Correct. Correct,
4 it is not funded.

5 MAYOR HENRY: And is there a
6 process to get that funded. Is that
7 part of the Record of Decision to get
8 funding for the next phase?

9 MR. SIVAK: This is a little
10 bet longer of an answer, let me use
11 the microphone.

12 As I think I tried to explain
13 this earlier, which is once we
14 memorialize our Record of Decision we
15 will begin negotiations with the
16 responsible party to enter into the
17 remedial design which is where we
18 actually, we plan all the nuts and
19 bolts how we would implement what our
20 final remedy will be.

21 That includes things like how
22 are we going to get the material off
23 the site and do some confirmatory
24 sampling and all those other details
25 that we need to take into account

1 Proceedings

2 before we actually get out there and
3 take the action and implement the
4 final remedy.

5 So we do have a responsible
6 party. We will be talking with them,
7 negotiating with them on that process.
8 That's the next step, is since we have
9 a responsible party we will be talking
10 with them about having them
11 participate in that remedial design.

12 MAYOR HENRY: Does the money
13 for that, is that included in your
14 estimated costs for the entire
15 project. The 70 million, does that
16 include it?

17 MS. SEPPI: Yes.

18 MR. SIVAK: Yes.

19 MAYOR HENRY: Do you have an
20 amount of what you think would be
21 required for the remedial design, what
22 is the amount of money required for
23 the next step?

24 MR. SIVAK: Well, the
25 estimates are -- the estimates we just

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2 presented are for that remedial
3 action. The design is not included in
4 that. So that's a separate pot of
5 money.

6 We would need to, if the
7 responsible party, again we are moving
8 more towards our enforcement area
9 which we don't necessarily like to
10 discuss because it's confidential, it
11 is something we would engage with the
12 responsible party, but in instances
13 where we would not have a responsible
14 party on the site we would take on
15 this action as a funding project, then
16 we would request the funding for the
17 remedial design so that we could move
18 forward with that.

19 MAYOR HENRY: So funding might
20 be an issue in the next phase?

21 MR. SIVAK: It might be. We
22 probably couldn't fund the whole
23 design in one lump sum. We would
24 probably have to incrementally fund
25 it.

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2 Designs are usually submitted
3 in several phases. So we would
4 probably request funding if it was a
5 funding project for these various
6 phases as we moved along.

7 MAYOR HENRY: And how long
8 does this design phase take. If it
9 record was to be funded. The Record
10 of Decision comes 2013, how long does
11 the design take for an average project
12 of this magnitude?

13 MR. SIVAK: So a typical
14 design takes about a year. Again
15 that's not including any negotiations
16 that we would have to get to that
17 point. So a typical design takes
18 about a year.

19 MAYOR HENRY: Does that
20 design, does that design, does that
21 include the restoration of any areas
22 of the town impacted by the removal
23 process. Does your design include the
24 restoration of infrastructure?

25 MR. SIVAK: To the extent that

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2 we can plan for restoration of the
3 town, yes, it would include that.

4 So, for example, if we know we
5 need to supplement a road or prove out
6 a road or something like that for
7 whatever reason, then, yes, it would
8 include those types of activities.

9 If during the implementation
10 of the remedy something would happen,
11 obviously we can't plan for that.
12 But, yes, for the extent we can plan
13 for improvements or for the types of
14 infrastructure that you are asking
15 about, yes, that would be within the
16 design.

17 MAYOR HENRY: So just based on
18 the information we're looking at a
19 minimum of 2013, 2014 before the
20 design is completed?

21 MR. SIVAK: Correct.

22 MAYOR HENRY: In the interim
23 is the EPA going to continue -- next
24 question, does EPA anticipate any
25 funds being contributed by the

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2 township of Old Bridge?

3 MR. SIVAK: Again, those would
4 be enforcement -- that's part of our
5 enforcement strategy and we're not
6 really prepared to talk about that in
7 a public forum such as this.

8 MAYOR HENRY: I didn't think
9 you would.

10 MR. SIVAK: Nice try, though.

11 MAYOR HENRY: It's on the
12 record.

13 And my last question is we're
14 looking at least a two-year window.
15 Is the EPA going to continue to
16 maintain the properties that they have
17 fenced off and signed and have --
18 continue to assist us on the other
19 side of the fence I should say where
20 we are not permitted to go?

21 MR. SIVAK: Sure.

22 MAYOR HENRY: And that is
23 funded.

24 MR. SIVAK: Well, yes, we will
25 be responsible for the maintenance of

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2 the fence. We will be responsible for
3 insuring that the site does not pose
4 an unacceptable risk. Yes, we will be
5 responsible for those activities.

6 MAYOR HENRY: Thank you.
7 Thank you very much.

8 MS. SEPPI: Thank you.

9 Bob. I'm surprised we still
10 have so many people here.

11 MR. SPIEGEL: Again Bob
12 Spiegel, Edison Wetlands.
13 S-P-I-E-G-E-L.

14 I just have a couple of just
15 real quick comments based on what was
16 presented a little bit earlier.

17 Before I just mention that I
18 wanted to just thank the CAG that has
19 really just worked so incredibly hard.
20 Also Dana Patterson because I know she
21 has put a lot of extra time. She has
22 gone above and beyond because this
23 community, she really believes in this
24 community as do I. I just wanted to
25 thank her for her hard work for all

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2 these last couple of years. Anybody
3 who has had the opportunity to work
4 with her realizes that she really is,
5 you know, a great spokesperson for
6 good quality of life and the
7 environment.

8 Also, I just wanted to -- I
9 had a couple actual questions and a
10 couple statements.

11 Real quickly, when we started
12 our organization actually 20 years
13 ago, it's our anniversary, and when we
14 first started we started to get one of
15 the sites that was in my backyard,
16 actually Dana's backyard, too at the
17 time. She was bicycling next to the
18 site. It was the CIC site, Chemical
19 Insecticide Corporation, and it was a
20 dioxin contaminated site.

21 We were told the same thing
22 that, you know, it's going to take a
23 long time, that it wasn't going to get
24 funded, but today CIC site is not only
25 fully remediated, they took out

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2 26 feet. They dug a giant hole right
3 next to 287. It's a park and was
4 purchased. I actually helped purchase
5 it with Green Acres money. So now
6 it's a park.

7 Twenty years later, it didn't
8 take that long, but, you know, that
9 work can be done. It just requires
10 people pay attention to what's going
11 on and what you guys have an advantage
12 is that the timeline for this
13 investigation has gone relatively
14 quickly. But EPA, I would make a
15 recommendation that, you know, they
16 are required by law to ask NL to do
17 the cleanup, but they should do what's
18 required by law obviously.

19 But once they do, they should
20 if NL balks at doing the cleanup, if
21 they try to play the games that they
22 are so good at which is to -- you
23 know, they are experts at a lot of
24 things. Environmental protection
25 isn't really one of them.

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2 Stalling, coming up with ways
3 to delay it, that's what they are
4 expert in at many sites and the person
5 who is in charge of NL I believe is a
6 billionaire and he can certainly
7 afford the spare change that falls out
8 of his pocket to clean up this site
9 because he has got the resources to do
10 it.

11 If you go to see Rescuing the
12 River, watch it online, you can really
13 just see, you know, what we are
14 dealing with and you really realize
15 they don't -- he doesn't have the best
16 interests of the community in mind.
17 He has the best interests of his
18 bottom line, but he can afford to pay
19 for this cleanup.

20 So EPA should go forward, give
21 him the opportunity, give NL the
22 opportunity to do the cleanup, and
23 they have the ability to do the
24 cleanup and use what's called treble
25 damages which is they can go after NL.

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2 That's still in existence, right,
3 treble damages?

4 MR. SIVAK: Under the correct
5 enforcement tool, yes.

6 MR. SPIEGEL: And they can
7 bill NL for up to three times the cost
8 if they don't do the cleanup. And
9 that's what EPA should do. They
10 should set the bar high. Tell NL what
11 they must do. If they don't do it,
12 EPA does the cleanup, bill NL for
13 three times the cost. Get the cleanup
14 done.

15 And as the mayor previously
16 said this is something that is going
17 to take proper planning and it's going
18 to have to take coordination. EPA is
19 usually very good with that and they
20 have health and safety plans that will
21 address every single one of the issues
22 that will be of impact to the
23 community and they will have to come
24 up with ways to mitigate that to the
25 extent that it is possible.

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2 The battery casings I saw in
3 the proposed plan, those are also
4 going to be included with this
5 cleanup?

6 MS. MITCHELL: Yes.

7 MR. SPIEGEL: We need to find
8 battery casings, from what I see the
9 battery casings are those little
10 broken up pieces. Is that what you're
11 talking about?

12 MS. MITCHELL: Yes.

13 MR. SPIEGEL: So those will
14 also be cleaned up as part of this.

15 MS. MITCHELL: Yes.

16 MR. SPIEGEL: And even if they
17 are in places where there is no slag
18 EPA will come up with some way to
19 remove it from the beaches so that
20 doesn't continue to wash in through
21 the tide.

22 MS. MITCHELL: Yes. If
23 they're not cleaned up as a pile then
24 they will be included in the soil or
25 sediment in the cleanup.

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2 MR. SPIEGEL: That's good.

3 One issue I just wanted to ask EPA, if
4 they got guidance from any agency
5 regarding the sediment criteria that
6 they used to establish the cleanup
7 rules for the Raritan Bay. Was EPA
8 was consulted by NOAA or any other
9 agencies regarding how you set the
10 standard for what is protective of the
11 bay?

12 MS. PENSAK: Yes. I
13 coordinate with the State EDP as well
14 as the trustees with NOAA as well as
15 Fish and Wildlife. So they are aware
16 and do support the cleanup value as
17 well as the remedy.

18 MR. SPIEGEL: So the 400
19 number that's going to be for the
20 sediment, NOAA concurs that that will
21 be protective of that fishery and has
22 the fact that people -- this is an
23 area that is commercial, there is
24 actually commercial harvesting of blue
25 claw crabs I think are harvested in

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2 this water. There is also a lot of
3 recreational fishery. Will that
4 number for the long term be protective
5 for the fisheries?

6 MR. SIVAK: Yes.

7 MR. SPIEGEL: So the trustees
8 have said that as well?

9 MS. PENSAK: I cannot directly
10 answer that. I know my counterpart is
11 in supportive of NOAA is in support of
12 this, but the fisheries, that's more
13 --

14 MR. SIVAK: We looked -- we
15 collected a variety of fish tissue
16 samples. We looked at what the risks
17 would be from people that would ingest
18 the fish, the fist and the hard clams
19 that are caught from this area and we
20 did not find any unacceptable risk.

21 MR. SPIEGEL: Okay. But
22 leaving that 400 number will be
23 protective of the fish and wildlife
24 that is there?

25 MR. SIVAK: Yes.

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2 MR. SPIEGEL: Last comment I
3 have is just I would like to see EPA
4 move forward expeditiously with this
5 cleanup and when they are doing the
6 work I would like to see them continue
7 with the strategy that has been so
8 successful here which is to use the
9 removal program and the resources of
10 the removal program in coming forward
11 with a remedial design so that they
12 move as quick as possible and as
13 safely as possible to get to the
14 design phase and have that complete so
15 that they can start the cleanup.

16 And the reason that I make
17 that recommendation and that
18 suggestion is because with the Raritan
19 Bay being an area that's so dynamic
20 they are going to have to do some
21 predesign sampling in order to come up
22 with what needs to be dredged, where
23 it needs to be taken from, and if
24 there is too much of a time lapse
25 between the time they collect the data

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2 and the time they start to work the
3 conditions may change if there is any
4 storm surges.

5 So the quicker they can
6 mobilize from the point where they
7 have the right amount of data for the
8 remedial design and actually going out
9 there and physically taking it out, it
10 will be very helpful to the cleanup
11 because we'll know where it is as
12 opposed to sometimes waiting a year or
13 two years between the remedial design
14 and the start of the remedial action.
15 And is there a way that EPA can
16 continue in this expedited fashion as
17 we move towards the actual cleanup?

18 MR. SIVAK: We recognize that
19 there is a need to move forward with
20 it and the comments that you made
21 about it being a dynamic environment
22 and doing additional sampling and any
23 lag between sampling -- I was hearing
24 it at the same time. Any lag between
25 sampling and action is, there is a lot

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2 of uncertainty with that. We
3 obviously recognize that.

4 We have been expediting this
5 process for the last three years and
6 we will continue to expedite it, but
7 we also have to move forward in a way
8 that is consistent with what our law
9 requires us to do as far as
10 negotiations, as far as good faith
11 negotiations.

12 But, yes, anything we can do
13 to expedite we will absolutely pursue
14 that right. Right, so any action that
15 we take, thank you, any action that we
16 take will include confirmatory
17 sampling to confirm that our remedy
18 that we have implemented did what it
19 was supposed to do, that we gotten rid
20 of what we said we would and that what
21 remains is protective of the public
22 health and the environment, that it
23 meets the goals and objectives we
24 discussed this evening.

25 MR. SPIEGEL: Thank you. And

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2 I know this, you know, is going to be
3 almost separate cleanups because you
4 are going to have a different type of
5 cleanup for the jetty versus the beach
6 versus Margaret's Creek, but if EPA
7 can find a way to expedite any of that
8 work so that it can be done in a
9 quicker fashion because the jetty is
10 going to have a much different set of
11 issues than, for example, the beach
12 will.

13 So maybe the EPA could stage
14 the work to get as much accomplished
15 as they can looking at how the best
16 way to stage, what should come first
17 and, you know, what should come last.

18 MR. SIVAK: Right. We had a
19 really great slide about the long
20 shore current and I don't know if any
21 of you remember that. Exactly. It
22 will be on the site. I know I did a
23 good job on that.

24 One of the things that is
25 going to really influence how that

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2 remedy is implemented is that long
3 shore current.

4 So we need to make sure that
5 we are as efficient as possible
6 implementing this remedy which means
7 that when we design it we're going to
8 have to make sure we design it and
9 implement that remedy from the areas
10 that are kind of at the beginning of
11 the tidal surge, that sort of tidal
12 flow and Margaret's Creek and then
13 kind of move down along the way.

14 So, yes, we understand what
15 you're saying. We know that there are
16 areas that the community would deem
17 more of a priority, maybe the beach,
18 but in order to not implement the
19 remedy, only to have it recontaminated
20 because we have sources that are still
21 in place that are kind of up current
22 from that or up gradient from that,
23 there is a specific way to implement
24 this remedy.

25 So I absolutely understand

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2 what you are saying, but we also have
3 other factors that are going to play
4 into that.

5 MR. SPIEGEL: And I know EPA
6 will absolutely -- the Mayor brought
7 up a concern about restoring what was
8 damaged during any remedial work, the
9 EPA generally has a policy that they
10 will restore the areas and I know the
11 promenade and that beautiful walkway,
12 you know, is going to likely have some
13 impact, but the EPA has been pretty
14 good at sites where people are
15 vigilant about making the areas
16 actually much better than they were to
17 begin with as far as improving the
18 amenities and making sure the areas
19 when they leave are -- that they look
20 as appealing and they look as
21 aesthetically pleasing and they
22 function as well as they did before
23 the cleanup.

24 So that's certainly a concern
25 I know that I am sure a lot of people

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2 share, but it's just a question of
3 being vigilant and working with the
4 agency so that they know what's
5 expected of them in terms of doing
6 their planning.

7 MS. SEPPI: Thank you, Bob.

8 MR. SPIEGEL: Thank you, Pat.
9 Dave, I wondered if you were going to
10 speak.

11 MR. MERWIN: David you know
12 how to spell it. Merwin, M-E-R-W-I-N
13 is the last name. I'm a member of the
14 CAG.

15 I got to keep asking these
16 million dollar questions because
17 everybody dances around them. How
18 long can NL, based upon tonight's
19 testimony from their attorney, I'm
20 sure that they are going to sit down
21 and talk with you, but how long can
22 they hold this project up?

23 A VOICE: Only as long as we
24 let them.

25 (Applause.)

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2 MR. SIVAK: We have an
3 obligation to sit down with them and
4 negotiate in good faith as we move
5 forward with this.

6 We do have an enforcement
7 strategy. I cannot talk about that
8 tonight. We have a process that we
9 have to follow. We have that process.

10 We've talked before with the
11 CAG about funding. We have talked
12 before how this project is going to
13 move forward and the options that we
14 have available to us, but we have to
15 follow that process.

16 We will enter into good faith
17 negotiations with the responsible
18 party. That's all I can tell you.

19 MR. MERWIN: But how long --
20 how long is a good faith negotiation?

21 MR. SIVAK: As long as we
22 believe that progress is being made,
23 then we will continue on with that
24 strategy.

25 MR. MERWIN: So once you stop

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2 then --

3 MR. SIVAK: Then we would
4 pursue other options under our
5 enforcement strategy.

6 One of those options may be
7 trying to pursue this as a fund
8 project, but again I can't go into
9 much more detail than that.

10 MAYOR HENRY: I just want NL
11 to know something. This is our beach.
12 This is not some field out -- brown
13 field out in the middle of nowhere.
14 This is our beach. This is our
15 recreational area. We have been
16 deprived of it long enough.

17 We expect NL to do the right
18 thing. The right thing is to support
19 the EPA Plan 2. Get the stuff out of
20 here. And I don't want to say get the
21 lead out of here because Q104 is going
22 to be suing because that's one of
23 their things. Every 8:00 o'clock in
24 the morning, 8:00 o'clock at night is
25 get the lead out but maybe we can have

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2 them start promoting this get the lead
3 out.

4 Please stop stalling. Let's
5 get it done. We can all get along
6 together. Thank you.

7 (Applause.)

8 MS. SEPPI: Thank you.

9 Andy. This is your first
10 time.

11 MR. ZABORNEY: Yes. Andrew
12 Z-A-B-O-R-N-E-Y. I'm a former
13 resident of Old Bridge, just moved
14 from Cliffwood Beach, but I was part
15 of the CAG, part of the community.
16 Obviously I have retired. I'm still
17 part of friends and family here.

18 A VOICE: Welcome back.

19 MR. ZABORNEY: Thank you.
20 EPA, thank you. NL, thank you. I
21 really mean that. Government big and
22 small, all government, thank you. And
23 I use the term government because
24 that's what we have, we have power to
25 the government. Write to your

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2 senators, write to your congressmen,
3 write to your mayors, write to your
4 councilmen. Show up at all the
5 meetings. Be heard. That's our
6 freedom. Be heard.

7 So if you owned a business you
8 would negotiate and I'm sitting there
9 well, this is just a matter of numbers
10 and the law has allowed NL, the law
11 has allowed EPA, the law has allowed
12 us by saying whatever is cost
13 effective. If you meet in the middle,
14 you both won't budge, what's cost
15 effective.

16 You're not going to want to
17 pay more than what you should be
18 paying for, period. That's -- I never
19 buy retail. I always buy things on
20 sale, but at a better bargain.

21 Well, it's the same exact
22 thing. Well, what if EPA and NL sat
23 down and said, okay, let's split the
24 cost. The community doesn't want it
25 in their backyard. NL doesn't want to

1 Proceedings

2 pay \$80 million. EPA doesn't want to
3 pay \$80 million. So we have Green
4 Acres funding.

5 And I'm sorry, NL has a point
6 1969, 1970's, whenever this all
7 occurred the State knew about it. It
8 was toxic. Maybe the town did. That
9 was Madison. I don't know. This has
10 to be investigated. It has to be. So
11 now you sit down and you negotiate.

12 Okay, NL will pay 50 percent.
13 They'll pay 50 percent, get Green
14 Acres funding, let the town and the
15 State put some Green Acres funding in
16 place and there you go. It's out of
17 the backyard. They're paying less.
18 Our taxes are paying less. It's
19 removed out and now the town has a
20 beautiful park again.

21 Now, that's the way I look at
22 it and I know it's wrong because
23 everyone is going to stall and
24 everyone is going to fight and that's
25 fine, that's what great about

1 Proceedings

2 democracy. We can do that. But I
3 would put that on the table.

4 I have no vested interest in
5 it. I just wanted to see the
6 community succeed, but if anybody was
7 ever going to say hey, let's not go to
8 litigation on this because I hate to
9 say that's what's going to happen.
10 It's going to go to litigation. It's
11 going to be this administration, the
12 next administration. It's going to be
13 another 15 years. That's what's going
14 to happen because NL is not going to
15 pay \$30 million. I don't blame them.
16 I respect that. But they have the
17 money to hold it up in litigation.

18 So whatever is going to be
19 done has to be decided fast. And if
20 you're saying it's going to take a
21 couple years to get a shovel in the
22 ground well, let's do it faster than a
23 couple of years, but it has to be
24 negotiated.

25 That's my prediction. And I

1 Proceedings

2 said this, I said this at one of the
3 CAG meetings. It's going to court.
4 That's what's going to happen. It's
5 going to get held up. It's going to
6 go to court.

7 I think if you at least sit
8 down together and have them negotiate
9 the price and split it, but that's a
10 perfect world and sometimes it's not
11 always a perfect world.

12 But thank you, and thank you
13 for welcoming me back. It's good to
14 see old friends and whatnot. Please
15 respect my statements. Thank you.

16 (Applause.)

17 MS. SEPPI: Teresa.

18 MS. SZAKIELO: Teresa
19 Szakielo, S-Z-A-K-I-E-L-O, I know I
20 was up here already, but I was -- I'm
21 just a mom from Lawrence Harbor. I'm
22 not part of any of the environment
23 groups or anything like that.

24 So my first thing is I was
25 under the impression that our tax

1 Proceedings

2 dollars were already going to be
3 paying for this fund because I wasn't
4 really sure how it was being paid for
5 because it was being talked about
6 shared responsibility. I already was
7 assuming that.

8 MR. SIVAK: No. Right now all
9 of the work has been down by the EPA.

10 MS. ZAKIELO: Okay. Okay.
11 The second thing that was very
12 disheartening to me is that money is
13 going to be the tiebreaker in the
14 decision for this because I have two
15 kids, seven and three who love that
16 park and I'm begging you guys from the
17 bottom of my heart don't put a
18 Band-Aid on something that needs to
19 take a long time.

20 Think about what you're doing
21 to the kids cause if my kids get sick
22 I'm going to be so upset. So if
23 somebody wants to drag their feet and
24 think that they are going to win and
25 in ten years everyone is going to be

1 Proceedings

2 sick anyway or have cancer or terrible
3 diseases, don't do it.

4 Just do what you think is
5 going to be best for the future of our
6 town. Sorry.

7 MS. SEPPI: That's okay.

8 (Applause.)

9 MS. SEPPI: You know what, we
10 pushed for three years to get where we
11 are now. We're not going to stop now.
12 We're going to keep pushing and
13 obviously everybody here is going to
14 help to get what we want and what we
15 think is best. we're not going to go
16 away.

17 We're still going to work
18 together and get this accomplished.
19 It's not going to be 15 years. Let's
20 hope it's not. No, it's not. It's
21 not.

22 Okay. George, I think maybe
23 if that could be the last question.
24 It's really getting kind of late and
25 we have a lot of people that have to

1 Proceedings

2 drive back to Long Island. We
3 certainty don't mind staying if there
4 is something we haven't talked about
5 yet, but I would like to close this
6 down after this question if that's
7 okay. I'm sorry, Samantha, you had
8 one too, right?

9 MR. BINETT: George Binett,
10 B-I-N-E-T-T.

11 The question is very brief
12 because especially the CAG members are
13 familiar with it and since the issue
14 has come up regarding the statement
15 that the laws say that the EPA has to
16 use the most effective cost program.

17 What can you give us now that
18 you couldn't give us a few months ago
19 about the decision by the National
20 Remedy Review Board regarding this
21 proposal because very few sites go to
22 the National Remedy Review Board.

23 MS. SEPPI: That's not really
24 true. Any site that has a proposed
25 remedy over \$25 million has to go

1 Proceedings

2 before the Remedy Review Board and
3 they make recommendations.

4 They don't tell us what to do.
5 We make the final decision in our
6 region. They may make recommendations
7 to us.

8 MR. SIVAK: Correct.

9 MS. SEPPI: But we can decide
10 to use or take their recommendations
11 or not.

12 MR. BINETT: But they have
13 endorsed this program.

14 MR. SIVAK: They do not
15 endorse the remedy. They look at our
16 responses to their comments. I want
17 to make sure everybody hears me. So
18 the Remedy Review Board provides a
19 memo to the region that includes
20 recommendations.

21 Those recommendations can be
22 things such as the region should
23 provide additional lines of evidence
24 to support a conclusion. The region
25 should evaluate the data in a way that

1 Proceedings

2 is consistent with National
3 Priorities, whatever it might be.
4 There is any number of reasons.

5 We provide -- the region then
6 provides responses to those
7 recommendations. Those responses may
8 include we believe the region has
9 sufficient data to support its
10 conclusion.

11 That's it. And then that is
12 how it works.

13 MR. BINETT: I get it. I get
14 it.

15 MS. SEPPI: Thank you. Okay.
16 Samantha. And if that's all right
17 with everybody we'll close the
18 meeting.

19 MS. MANBURG: Samantha Manburg
20 again. The question is you mentioned
21 for the design phase that you would
22 first have to sit with National Lead
23 and develop a design and my question
24 is we have also talked in the CAG
25 meetings about the CAG having input in

1 Proceedings

2 the design phase.

3 So I wondered at what point
4 does the CAG get to have input if the
5 first portion is the two of you meet
6 together and it's all private.

7 MR. SIVAK: No. No. The
8 discussion of the design is not
9 private.

10 MS. SEPPI: Yes.

11 MR. SIVAK: Right. Just the
12 negotiation part is private.

13 MS. MANBURG: So that's just
14 money?

15 MR. SIVAK: Yes. The
16 discussion of money, responsibility,
17 legal authority, things like that.
18 That's an enforcement discussion.
19 That is a private issue.

20 Once those responsibilities
21 and goals are defined, then we
22 actually move into conversations about
23 how would this remedy look. How would
24 we design this remedy so that it can
25 be implemented. That is a public --

1 Proceedings

2 that is the time we will engage the
3 CAG. We will ask for input where we
4 would present steps in the process to
5 the CAG and to the community as well.

6 There are several -- the
7 design is structured such that there
8 are several milestones along the way.
9 We don't just come and say look,
10 here's a complete design, we are ready
11 to go. We want to talk to you about
12 it.

13 First of all, it's never going
14 to be this thin. Second of all, it's
15 going to take a while to develop. At
16 these milestone points those are good
17 opportunities to kind of come back to
18 the community and say this is kind of
19 where we are or we're talking about, I
20 don't know, we wanted to know when
21 kids are on the street or when school
22 starts in the morning so we can
23 minimize the amount of overlap between
24 vehicular traffic and when children
25 are in school, it's something like

1 Proceedings

2 that.

3 MS. MANBURG: Thank you.

4 MR. SIVAK: And by the way
5 since I have the microphone, there has
6 been a lot of thank yous going on. I
7 want to thank all the people who tried
8 to help us get this presentation
9 trying. You're one, you're one, Bob
10 and everybody helped us so much.

11 Again the slides and that
12 presentation will be available early
13 next week. It's really good. You
14 should look at it and thank you all
15 for your help with that.

16 (Applause.)

17 MS. SEPPI: Thank you very
18 much. And I think if Michael ever
19 leaves the EPA maybe he can do
20 stand-up comedy. Thank you again.
21 We'll be in touch soon.

22 (Whereupon, at 11:00 o'clock
23 p.m., the proceedings were concluded.)

24

25

C E R T I F I C A T E

STATE OF NEW YORK)

) ss.

COUNTY OF NEW YORK)

I, TINA DeROSA, a Shorthand
(Stenotype) Reporter and Notary Public
of the State of New York, do hereby
certify that the foregoing
Proceedings, taken at the time and
place aforesaid, is a true and correct
transcription of my shorthand notes.

I further certify that I am
neither counsel for nor related to any
party to said action, nor in any wise
interested in the result or outcome
thereof.

IN WITNESS WHEREOF, I have
hereunto set my hand this 22nd day of
October, 2012.



TINA DeROSA

APPENDIX E – Administrative Record Index

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123494

Bates:

To:

Date: 05/22/2013

Pages: 12

Title: ADMINISTRATIVE RECORD INDEX FOR OU1 FOR THE RARITAN BAY SLAG SITE

Doc Type: INDEX

Name	Organization
Author: ,	US ENVIRONMENTAL PROTECTION AGENCY REGION 2
Name	Organization

Region ID: 02

Doc ID: 145542

Bates: R2-0000001

To: R2-0000055

Date: 02/23/2009

Pages: 55

Title: HEALTH CONSULTATION - EVALUATION OF ENVIRONMENTAL DATA FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

Name	Organization
Author: ,	U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Name	Organization

Region ID: 02

Doc ID: 123872

Bates: R2-0000056

To: R2-0002299

Date: 06/01/2010

Pages: 2244

Title: FINAL REVISED DATA GAP EVALUATION TECHNICAL MEMORANDUM FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, RARITAN BAY SLAG SUPERFUND SITE

Doc Type: REPORT

Name	Organization
Author: ,	CDM
Name	Organization

Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123873

Bates: R2-0002300

To: R2-0002422

Date: 08/18/2010

Pages: 123

Title: FINAL ACCIDENT PREVENTION PLAN, REVISION 1 FOR SLAG DISTRIBUTION STUDY,
RARITAN BAY SLAG SUPERFUND SITE

Doc Type: PLAN

<u>Name</u>	<u>Organization</u>
Author: ,	CDM

<u>Name</u>	<u>Organization</u>
Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

Region ID: 02

Doc ID: 123541

Bates: R2-0002423

To: R2-0002520

Date: 08/20/2010

Pages: 98

Title: FINAL BEACH DEBRIS AND TIMBER REMOVAL LETTER REPORT FOR THE RARITAN BAY
SLAG SITE

Doc Type: LETTER

<u>Name</u>	<u>Organization</u>
Author: LEONARD , EDWARD	CDM

<u>Name</u>	<u>Organization</u>
Addressee: STEIN, KRISTINE	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
MITCHELL, TANYA	EPA, REGION 2

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123876

Bates: R2-0002521

To: R2-0002788

Date: 09/01/2010

Pages: 268

Title: FINAL WORK PLAN FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, RARITAN BAY SLAG SUPERFUND SITE

Doc Type: PLAN

Name	Organization
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Author: ,	CDM
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Name	Organization
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Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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Region ID: 02

Doc ID: 123874

Bates: R2-0002789

To: R2-0003175

Date: 09/17/2010

Pages: 387

Title: FINAL QUALITY ASSURANCE PROJECT PLAN FOR EARLY ACTIONS, REVISION 1 FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, RARITAN BAY SLAG SUPERFUND SITE

Doc Type: PLAN

Name	Organization
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Author: ,	CDM
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Name	Organization
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Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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Region ID: 02

Doc ID: 123875

Bates: R2-0003176

To: R2-0003306

Date: 09/27/2010

Pages: 131

Title: FINAL ACCIDENT PREVENTION PLAN FOR REMEDIAL INVESTIGATION ACTIVITIES, RARITAN BAY SLAG SUPERFUND SITE

Doc Type: PLAN

Name	Organization
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Author: ,	CDM
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Name	Organization
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ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

<u>Name</u>	<u>Organization</u>
Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

Region ID: 02

Doc ID: 123877

Bates: R2-0003307

To: R2-0003794

Date: 10/29/2010

Pages: 488

Title: FINAL QUALITY ASSURANCE PROJECT PLAN FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, RARITAN BAY SLAG SUPERFUND SITE

Doc Type: PLAN

<u>Name</u>	<u>Organization</u>
Author: ,	CDM

<u>Name</u>	<u>Organization</u>
Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

Region ID: 02

Doc ID: 123538

Bates: R2-0003795

To: R2-0003823

Date: 11/01/2010

Pages: 29

Title: FINAL WORK PLAN CURRENTS AND SEDIMENTS DYNAMICS STUDIES FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
Author: ,	WOODS HOLE GROUP

<u>Name</u>	<u>Organization</u>
Addressee: CDM,	CDM FEDERAL PROGRAMS CORP

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FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123450

Bates: R2-0003824

To: R2-0004070

Date: 11/01/2010

Pages: 247

Title: FINAL TEST EXCAVATION DATA SUMMARY REPORT FOR THE RARITAN BAY SLAG
SUPERFUND SITE

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
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Author: ,	CDM
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<u>Name</u>	<u>Organization</u>
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Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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Region ID: 02

Doc ID: 123451

Bates: R2-0004071

To: R2-0004477

Date: 12/01/2010

Pages: 407

Title: FINAL BEACH SAMPLING TECHNICAL MEMEORADUM FOR THE RARITAN BAY SLAG
SUPERFUND SITE

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
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Author: ,	CDM
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<u>Name</u>	<u>Organization</u>
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Addressee: ,	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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Region ID: 02

Doc ID: 145543

Bates: R2-0004478

To: R2-0004525

Date: 01/02/2011

Pages: 48

Title: COMMUNITY INVOLVEMENT PLAN FOR THE RARITAN BAY SLAG SITE

Doc Type: PLAN

<u>Name</u>	<u>Organization</u>
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Author: ,	US ENVIRONMENTAL PROTECTION AGENCY REGION 2
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<u>Name</u>	<u>Organization</u>
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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123539

Bates: R2-0004526

To: R2-0004617

Date: 02/23/2011

Pages: 92

Title: FINAL CONTRACTOR QUALITY CONTROL PLAN REVISION NO. 1 FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

Name

Organization

Author: TSANG, FRANK

CDM FEDERAL PROGRAMS CORP

Name

Organization

Addressee: ,

US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

Region ID: 02

Doc ID: 145548

Bates: R2-0004618

To: R2-0005427

Date: 09/23/2011

Pages: 810

Title: REVISED FINAL FEASIBILITY STUDY REPORT FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

Name

Organization

Author: ,

CDM SMITH

Name

Organization

Region ID: 02

Doc ID: 140093

Bates: R2-0005428

To: R2-0006575

Date: 12/13/2011

Pages: 1148

Title: HUMAN HEALTH RISK ASSESSMENT REPORT - APPENDIX T OF THE FINAL REMEDIAL INVESTIGATION REPORT FOR THE RARITAN BAY SLAG SUPERFUND SITE

Doc Type: REPORT

Name

Organization

Author: ,

CDM

Name

Organization

Addressee: ,

EPA, REGION 2

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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 140094

Bates: R2-0006576

To: R2-0006751

Date: 12/13/2011

Pages: 176

Title: SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT REPORT - APPENDIX U OF THE FINAL REMEDIAL INVESTIGATION REPORT FOR THE RARITAN BAY SLAG SUPERFUND SITE

Doc Type: REPORT

	<u>Name</u>	<u>Organization</u>
Author: ,		CDM

	<u>Name</u>	<u>Organization</u>
Addressee: ,		EPA, REGION 2

Region ID: 02

Doc ID: 145550

Bates: R2-0006752

To: R2-0006988

Date: 06/15/2012

Pages: 237

Title: FINAL ADDENDUM TO THE FINAL SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT REPORT FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

	<u>Name</u>	<u>Organization</u>
Author: ,		CDM SMITH

	<u>Name</u>	<u>Organization</u>

Region ID: 02

Doc ID: 123900

Bates: R2-0006989

To: R2-0008275

Date: 06/25/2012

Pages: 1287

Title: FINAL REMEDIAL INVESTIGATION REPORT WITH ERRATA SHEETS - TEXT, TABLES, AND FIGURES - VOLUME 1 OF 2 FOR THE RARITAN BAY SLAG SUPERFUND SITE

Doc Type: REPORT

	<u>Name</u>	<u>Organization</u>
Author: ,		CDM

	<u>Name</u>	<u>Organization</u>
Addressee: ,		EPA, REGION 2

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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 123901

Bates: R2-0008276

To: R2-0015255

Date: 06/25/2012

Pages: 6980

Title: APPENDICES A THROUGH S OF THE FINAL REMEDIAL INVESTIGATION REPORT - VOLUME 2 OF 2 FOR THE RARITAN BAY SLAG SUPERFUND SITE

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
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Author: ,	CDM
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<u>Name</u>	<u>Organization</u>
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Addressee: ,	EPA, REGION 2
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Region ID: 02

Doc ID: 145545

Bates: R2-0015256

To: R2-0015261

Date: 08/28/2012

Pages: 6

Title: TECHNICAL MEMORANDUM REGARDING THE ADDENDUM TO THE FINAL REMEDIAL INVESTIGATION REPORT DATED DECEMBER 2011 FOR THE RARITAN BAY SLAG SITE

Doc Type: MEMORANDUM

<u>Name</u>	<u>Organization</u>
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Author: SCORCA, MICHAEL	U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 2
SMITH, LORA M	US ENVIRONMENTAL PROTECTION AGENCY

<u>Name</u>	<u>Organization</u>
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Addressee: MITCHELL, TANYA	EPA, REGION 2
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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 145546

Bates: R2-0015262

To: R2-0015264

Date: 09/12/2012

Pages: 3

Title: NJDEP CLASS III-B GROUND WATER CLASSIFICATION FOR THE RARITAN BAY SLAG SITE

Doc Type: LETTER

Name

Organization

Author: MUMFORD, FRED

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Name

Organization

Addressee: MITCHELL, TANYA

EPA, REGION 2

Region ID: 02

Doc ID: 145544

Bates: R2-0015265

To: R2-0015276

Date: 09/17/2012

Pages: 12

Title: RESPONSE TO NATIONAL REMEDY REVIEW BOARD COMMENTS REGARDING THE
RARITAN BAY SLAG SITE

Doc Type: MEMORANDUM

Name

Organization

Author: FRISCO, JOHN S

EPA, REGION 2

Name

Organization

Addressee: LEGARE, AMY R

EPA

Region ID: 02

Doc ID: 145553

Bates: R2-0015277

To: R2-0015300

Date: 09/26/2012

Pages: 24

Title: PROPOSED PLAN FOR THE RARITAN BAY SLAG SITE

Doc Type: PLAN

Name

Organization

Author: ,

US ENVIRONMENTAL PROTECTION AGENCY

Name

Organization

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05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 145547

Bates: R2-0015301

To: R2-0015308

Date: 07/05/2012

Pages: 8

Title: NATIONAL REMEDY REVIEW BOARD RECOMMENDATIONS FOR THE RARITAN BAY SLAG SITE

Doc Type: MEMORANDUM

<u>Name</u>	<u>Organization</u>
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Author: LEGARE, AMY R	EPA
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<u>Name</u>	<u>Organization</u>
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Addressee: MUGDAN, WALTER E	EPA, REGION 2
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Region ID: 02

Doc ID: 145619

Bates: R2-0015309

To: R2-0015309

Date: 02/01/2012

Pages: 1

Title: US ARMY CORPS OF ENGINEERS COMMENTS ON THE DRAFT FEASIBILITY STUDY REPORT FOR THE RARITAN BAY SLAG SITE

Doc Type: MEMORANDUM

<u>Name</u>	<u>Organization</u>
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Author: HINTZ, RANDALL G	US ARMY CORPS OF ENGINEERS
---------------------------------	----------------------------

<u>Name</u>	<u>Organization</u>
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Addressee: STEIN, KRISTINE	US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT
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Region ID: 02

Doc ID: 684072

Bates: R2-0015310

To: R2-0015369

Date: 09/28/2012

Pages: 60

Title: CASE STUDIES IN SEA LEVEL RISE PLANNING - PUBLIC ACCESS IN THE NEW YORK - NEW JERSEY HARBOR ESTUARY

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
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<u>Name</u>	<u>Organization</u>
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Addressee: BOICOURT, KATE	NY-NJ HARBOR & ESTUARY PROGRAM
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KING, SUSANNAH	NEW ENGLAND INTERSTATE WATER POLLUTION
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ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

<u>Name</u>	<u>Organization</u>
	CONTROL COMMISSION

Region ID: 02

Doc ID: 684071

Bates: R2-0015370

To: R2-0015390

Date: 01/08/2013

Pages: 21

Title: PRESENTATION SLIDES FOR THE CAG MEETING ON 01/08/2013 FOR THE RARITAN BAY SLAG SITE

Doc Type: PHOTOGRAPH

<u>Name</u>	<u>Organization</u>
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<u>Name</u>	<u>Organization</u>
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Region ID: 02

Doc ID: 684073

Bates: R2-0015391

To: R2-0015394

Date: 04/22/2013

Pages: 4

Title: POLLUTION REPORT NO. 2 - PROGRESS FOR THE RARITAN BAY SLAG SITE

Doc Type: REPORT

<u>Name</u>	<u>Organization</u>
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Author: CONFORTINI, ANDREW L

EPA

<u>Name</u>	<u>Organization</u>
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Addressee: PLEVIN, LISA

US ENVIRONMENTAL PROTECTION AGENCY
REGION 2

ROTOLO, JOSEPH

EPA

ENCK, JUDITH A

EPA, REGION 2

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

FINAL

05/22/2013

Region ID: 02

Site Name: RARITAN BAY SLAG

CERCLIS: NJN000206276

OUID: 01

SSID: A205

Action:

Region ID: 02

Doc ID: 192741

Bates: R2-0015395

To: R2-0015395

Date: 05/22/2013

Pages: 1

Title: ADDENDUM TO THE HUMAN HEALTH RISK ASSESSMENT FOR THE RARITAN BAY SLAG SITE

Doc Type: MEMORANDUM

Name

Organization

Author: SMITH, LORA M

US ENVIRONMENTAL PROTECTION AGENCY

Name

Organization

Addressee: MITCHELL, TANYA

EPA, REGION 2

APPENDIX F – State Letter of Concurrence



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
SITE REMEDIATION PROGRAM

Mail Code 401-06

P. O. Box 420

Trenton, New Jersey 08625-0420

Tel. #: 609-292-1250

Fax. #: 609-777-1914

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

May 8, 2013

Mr. Walter Mugdan, Director
Emergency and Remedial Response Division
U.S. Environmental Protection Agency
Region II
290 Broadway
New York, NY 10007-1866

Re: Raritan Bay Slag Superfund Site
Record of Decision
CERCLIS ID NJN000206276
DEP PI#514709

Dear Mr. Mugdan:

The New Jersey Department of Environmental Protection (DEP) completed its review of the "Record of Decision, Raritan Bay Slag Site, Old Bridge/Sayreville, New Jersey" prepared by the U.S. Environmental Protection Agency (EPA) Region II in May 2013 and concurs with the selected remedy to address lead slag contamination in soil and sediment along the Raritan Bay waterfront.

DEP supports excavation, dredging and off-site removal of lead-contaminated soils and sediments under the selected remedy estimated at \$78.7 million. Limited surface water monitoring is included in the plan to be conducted post removal to confirm all waste sources have been removed.

The selected remedy is noteworthy because it is an unrestrictive cleanup and there are no institutional controls required. Furthermore, the Remedial Investigation was completed within three years of listing on the National Priorities List of Superfund sites. DEP's early site investigation work for an Old Bridge open space proposal led to the discovery of the placement of slag and battery casings at the site. As was later confirmed by EPA's removal and remedial branches, this past waste disposal activity resulted in contaminated slag, battery casing and associated wastes impacting soils and sediments in the Cheesequake jetty, Laurence Harbor seawall and Margaret's Creek wetlands.

The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the Administrative Record file for this site. The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

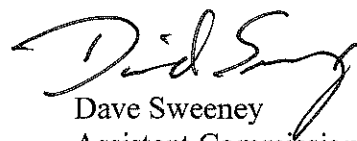
The components of the Selected Remedy include:

1. Remediation of Slag, Battery Casing/Associated Wastes: Slag, battery casing/associated wastes will be excavated based on visual observation and disposed of at appropriate off-site facilities. Slag materials that are not readily visible will be remediated as soil/sediment.
2. Surface Water: The approach to remediating the surface water contamination at the site is to remove the principal threat wastes that act as sources of contamination to the surface water. This will reduce the surface water contamination over time to acceptable levels. Monitoring will be implemented to assess the effectiveness of the remedy.
3. Soil and Sediments: Contaminated soils and sediment above the lead remediation cleanup level of 400 mg/kg would be excavated and/or dredged and disposed of at appropriate off-site facilities.

DEP appreciates the opportunity to participate in the decision making process to select an appropriate remedy and is looking forward to future cooperation with EPA in remedial action at this site.

If you have any questions, please call me at 609-292-1250.

Sincerely,



Dave Sweeney
Assistant Commissioner
Site Remediation Program

C: Ken Kloo, Director, Division of Remediation Management, DEP
Ed Putnam, Assistant Director, Publicly Funded Response Element, DEP
Carole Petersen, Chief, New Jersey Remediation Branch, EPA Region II

APPENDIX G – Public Comments

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November 27, 2012

Ms. Tanya Mitchell
U.S. Environmental Protection Agency,
Region 2
290 Broadway, 19th Floor
New York, NY 10007

Re: ***Raritan Bay Slag Superfund Site***
Comments on the Proposed Remedial Action Plan

Dear Ms. Mitchell:

Enclosed please find the Comments of NL Industries, Inc. ("NL") on the Proposed Remedial Action Plan ("PRAP") for the Raritan Bay Slag Site (the "Site"). NL's Comments respond to the information released by EPA as of September 28, 2012, the date of the PRAP. To the extent EPA will rely upon additional samples taken after the PRAP was released, or to the extent EPA has changed its interpretation of the previous samples or data, NL asks that it be given the opportunity to comment on that new information.

In the event EPA would like to clarify or discuss any of NL's Comments before responding in writing, please feel free to contact me at the number above.

Very truly yours,



CHRISTOPHER R. GIBSON

CRG:rg
Attachments

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NL COMMENTS TO EPA SEPTEMBER 28, 2012
PROPOSED REMEDIAL ACTION PLAN FOR RARITAN BAY SLAG SITE

INTRODUCTION

NL Industries, Inc. (“NL”) submits these Comments on the Proposed Remedial Action Plan (“PRAP”) issued by the United States Environmental Protection Agency (“EPA”) for the Raritan Bay Slag Site (the “Site”) on September 28, 2012. NL’s Comments¹ identify significant concerns associated with EPA’s preferred Site remedy described in the PRAP and the process EPA followed to select that preferred remedy – concerns that if not addressed and rectified prior to the issuance of a Record of Decision will result in a remedy selection that is arbitrary, capricious and inconsistent with the National Contingency Plan (“NCP”).

Although each of NL’s Comments is specific (and should be responded to separately), several Comments explain why EPA cannot choose a total off-site disposal remedy like its preferred remedy, “Alternative 2,” without running afoul of the “cost effectiveness” requirement of the NCP. Instead, because the off-site disposal of slag and other impacted material is no more effective than on-site containment, but is twice as expensive, EPA must select a remedy that places as much slag and impacted material as possible in an on-Site containment unit to comply with the NCP. In addition, NL’s Comments identify proven techniques that EPA should employ to reduce the volume and cost of addressing impacted materials under any of the alternatives considered by EPA.

¹ NL’s Comments incorporate and include all exhibits and attachments referenced herein. NL respectfully requests that all of NL’s Comments (including all attachments and exhibits submitted by NL) be included in the Administrative Record for the Site. In addition to its electronic submission, NL is providing four paper copies and four electronic copies of the Comments (including all exhibits and attachments) to EPA via Federal Express.

NL has been working in good faith with EPA, the Township of Old Bridge and others for over two years to determine environmental response actions that are appropriate for this Site. NL has contracted a nationally recognized environmental engineering and consulting firm, Advanced GeoServices Corporation ("Advanced GeoServices"), to assist NL in the review of the Administrative Record for the Site as well as other documents provided to NL by EPA pursuant to information requests. Advanced GeoServices is very familiar with the Site and the Administrative Record and has more than 25 years of experience working on a variety of Superfund sites, including many that are very similar to this Site, where lead is the contaminant of concern. Advanced GeoServices has reviewed the tens of thousands of pages of data, reports and other information specific to the Site and has performed an independent review and analysis of the remedial alternatives considered by EPA and the remedy proposed in the PRAP. Advanced GeoServices prepared a series of reports and NL presents those reports as an essential part of its Comments to the PRAP.

COMMENTS OF NL INDUSTRIES, INC.

Comment No. 1. – EPA Should Select a Remedy That Places As Much Material As Possible in An On-Site Containment Unit and Considers Techniques to reduce Volume and Costs.

As set forth in many of the following Comments, off-site disposal of slag and other material is twice as expensive as on-site containment but is equal to off-site disposal in overall protectiveness. For that reason, off-site disposal (EPA's preferred remedy Alternative 2) does not comply with the "cost effectiveness" requirement of CERCLA and the NCP. Accordingly, in order to comply with the NCP's "cost effectiveness" requirement, EPA must consider and adopt a remedy that places as much of the slag and other source material as possible in an on-site containment unit. It does not appear that any of the Alternatives considered by EPA in the

Revised Feasibility Study meet this mandate, but EPA is required to consider and adopt such a remedy.

In addition, whether the material is contained on-site or off-site, EPA should select a remedy that uses various proven techniques, such as soil washing, to reduce volume and cost as much as possible. As set forth more fully in the Comments that follow, EPA has failed to fully evaluate soil washing and other mechanical separation techniques, as well as on-site treatment to address any landfill requirements that would reduce the volume and cost of the remedy. If feasible and cost-effective, any remedy EPA implements should use such techniques as much as possible.

Comment No. 2. – Alternative 2, the Total Off-Site Disposal Remedy Preferred by EPA, Does Not Meet the Mandate of Cost-Effectiveness as Required by the NCP.

EPA has not yet documented whether or how it has determined that its preferred remedy (Alternative 2) is “cost effective,” as that term is used in CERCLA and the NCP. Given the relevant facts, and EPA’s prior findings, EPA will never be able to establish that Alternative 2 is cost effective under the NCP. The failure to document this analysis is significant, because EPA may only select a remedy that is “cost effective.” CERCLA Section 121(a) states:

Selection of remedial action

The President shall select appropriate remedial actions . . . which provide for cost-effective response. **In evaluating the cost effectiveness of proposed alternative remedial actions, the President shall take into account the total short- and long-term costs of such actions, including the costs of operation and maintenance for the entire period during which such activities will be required.**

42 U.S.C. § 9621(a) (emphasis added); *see also* 42 U.S.C. § 9621(b)(1) (“The President shall select a remedial action . . . that is cost effective.”)

Section 300.430(f)(1)(ii)(D) of the NCP defines the factors that EPA must use to determine whether a remedy is cost effective:

(D) *Each remedial action selected shall be cost-effective*, provided that it first satisfies the threshold criteria set forth in § 300.430(f)(1)(ii)(A) and (B).² Cost-effectiveness is determined by evaluating the following *three* of the five balancing criteria noted in § 300.430(f)(1)(i)(B)³ to determine overall effectiveness: [1] long-term effectiveness and permanence, [2] reduction of toxicity, mobility, or volume through treatment, and [3] short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost-effective. A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.

40 CFR § 300.430(f)(1)(ii)(D) (emphasis added).

As set forth in the NCP, to determine “cost effectiveness,” the Region must first evaluate the “overall effectiveness” of the remedy. *Id.* The only criteria used to evaluate “overall effectiveness” under the NCP are (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, volume (T/M/V) through treatment (“reduction of T/M/V through treatment”); and (3) short-term effectiveness. *Id.*

²The “threshold criteria site” require that a remedy “be protective of human health and the environment,” and that it utilize ARARs or fall within an exception. There is no dispute that both the on-site containment and off-site disposal remedies all satisfy the threshold criteria set forth in 40 CFR § 300.430(f)(1)(ii)(A) and (B). See *Revised Feasibility Study (“Revised FS”)* at § 4.5.1 (“Alternatives 2 through 5 would provide protection to human health and the environment.”); § 4.5.2 (“Alternatives 2 through 5 would comply with chemical-specific ARARs through removal and off-site disposal or on- containment.”).

³ The five “balancing criteria” are (1) long-term effectiveness and permanence, (2) reduction of toxicity, mobility or volume through treatment, (3) short-term effectiveness, (4) implementability, and (5) cost. 40 CFR § 300.430(f)(1)(i)(B). In addition to the five “balancing criteria,” the NCP also defines “state and community acceptance” as additional “modifying criteria.” 40 CFR § 300.430(f)(1)(i)(C). Although only three of the “balancing criteria” are considered when determining cost-effectiveness under NCP subsection (f)(1)(ii)(D), all five of the balancing criteria and the “modifying criteria” of state and community acceptance are considered when determining whether a remedy uses “permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable” under NCP subsection (f)(i)(E).

Other “evaluation criteria” identified in the NCP, such as “state and community acceptance” and “implementability” are not used to evaluate whether a remedial action is “cost-effective.” *See id.* Instead, criteria such as “community acceptance” are used only in evaluating other aspects of the remedy, such as whether it utilizes “permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.” 40 CFR § 300.430(f)(1)(ii)(E) (stating that “the modifying criteria of state acceptance and community acceptance described in paragraph (f)(1)(i)(C) of this section shall also be considered”).

Here, the decision documents do not include any evaluation of “cost-effectiveness” using the method required by the NCP. However, the EPA did make findings on all three of the criteria used to evaluate “overall effectiveness” in its decision documents. In EPA’s Public Meeting Presentation, for example, the EPA stated that Alternatives 2 – 5 all “meet[] criteria” for “long-term effectiveness and permanence.” (*See* attached as Exhibit “R,” page 43 of EPA’s October 2, 2012 Public Meeting Presentation.) EPA also stated that Alternatives 2 – 5 all “meet[] some criteria” for reduction of T/M/V through treatment because they all use “[t]reatment only to meet LDR requirements.” (Ex. R.) Finally, EPA found that Alternatives 2 – 5 all “meet[] some criteria for short-term effectiveness” because they all would have “temporary impacts to aquatic habitat and local community.” (Ex. R.) These findings establish that, with regard to the three NCP criteria, all on-site containment alternatives have the same “overall effectiveness” as the total off-site disposal alternative preferred by EPA.

The decision documents do not address whether the cost of each remedial alternative is proportional to its “overall effectiveness” as required by the NCP to determine whether each alternative is “cost effective.” Instead, the decision documents simply disclose the cost of each

remedial alternative. Those costs range from \$49.8 million for Alternative 4 (which includes on-site containment) to \$78.7 million for total off-site disposal in Alternative 2. *See Revised FS at ES-14.* Thus, although the EPA's findings establish that the "overall effectiveness" of the remedies as measured by the criteria in 40 CFR § 300.430(f)(1)(ii)(D) is the same, Alternative 2 is \$28.9 million (or 58%) more expensive than Alternative 4. *See Revised FS at ES-14.* As discussed in greater detail in later Comments, disposing of the slag in an on-site containment structure is half the cost of off-site disposal, and the actual differential between the EPA's preferred total off-site disposal remedy and an on-site containment remedy is likely much greater than \$30 million.

The bottom line is that EPA's own findings and documents show that its preferred remedy, the total off-site disposal alternative, is tens of millions of dollars more expensive than remedies that include on-site containment, but is not any more effective or protective of human health or the environment. The EPA National Remedy Review Board ("NRRB") questioned EPA's preference for the total off-site alternative given the availability of equally protective on-site remedies at a fraction of the cost. (See attached as Exhibit "N" the NRRB Comments to EPA at 7.) Under EPA's analysis, for example, the majority of impacted soils and sediments would not fail TCLP, and thus would not pose any real risk of "leaching." Yet EPA still wants all material sent off-site to a landfill rather than placed on-site in a secure containment feature. It seems clear that the real reason for EPA's identification of the total off-site alternative as its preferred choice is what EPA admits in its Response to the NRRB the local community, the State, and the USACE would prefer to have the material moved off-site and into someone else's backyard. However, under the NCP, EPA must select a remedy that is cost effective. *As a matter of law, EPA cannot choose a significantly more expensive remedy over one having the*

same overall effectiveness simply because local citizens and/or state environmental agency officials prefer a more expensive remedy.

Put another way, when the remedies are equally effective, cost is the tiebreaker. Accordingly, it would be arbitrary and capricious for EPA to select Alternative 2. The following six comments discuss the “overall effectiveness,” under the NCP, of remedies that include on-site containment.

Comment No. 3. – Remedies Including On-Site Containment Are Fully Protective of Human Health and the Environment.

EPA correctly found that the three remedies considered in the Revised Feasibility Study (“Revised FS”) that involve on-site containment of source material (Alternatives 3, 4 and 5) all satisfy the criteria for “overall protection of human health and the environment” set forth at 40 CFR § 300.430(f)(1)(ii)(A) as effectively as the total off-site remedy selected by EPA. As noted on page 4-50 of the Revised FS, “Alternatives 2 through 5 would provide protection to human health and the environment. . . . [f]or Alternatives 3 through 5, human health risks would be eliminated or greatly reduced through removal and containment of contaminated materials; however, long-term maintenance of the containment cells would be required.” *Revised FS at 4-50*. EPA repeated these findings on slide 43 of its Public Meeting Presentation, dated 10-22-2012, which stated that Alternatives 3 through 5 each “meet[] criteria” for Overall Protection of Human Health and the Environment. (Ex. R at 43.)

EPA’s conclusion that on-site containment of lead source material is protective of human health and the environment is well supported on technical grounds, and there are numerous case studies demonstrating that this approach presents a sound, protective remedial solution for these types of materials. Lead, the contaminant of concern at the Site, is not highly mobile. Even in

the unprotected environment within the bay, the lead in the slag pots, which has been present for over 40 years, has not migrated far from the location where it originally was deposited. As described more fully in the Advanced GeoServices Lead Mobility Technical Report, attached as Exhibit “E,” this is partly because the lead is essentially insoluble in the bay environment, and the principal transport mechanism is mechanical weathering.

A containment remedy would effectively address the lead concern by isolating the soils, sediments and source materials. The site materials would be placed within a landfill type cell designed using proven technologies to prevent all exposures, including the infiltration of surface water or groundwater. According to the Advanced GeoServices On-Site Containment Cell Technical Report, attached as Exhibit “A,” this type of containment system is routinely used on Superfund Sites and there are a variety of mechanisms to ensure isolation of the materials.

Hurricane Sandy has shown that the primary lead source material (the slag pots) is well-suited for on-site containment and that the location of the containment cell proposed in Alternatives 3 – 5 would not be heavily impacted by even the most severe storm surges the area has ever experienced. (Attached as Exhibit “B,” is the Advanced GeoServices Post Sandy Upland Area Condition Technical Report documenting the condition of the upland area after the “Sandy” storm of October 29-30, 2012.) Advanced GeoServices conducted a site visit days after Sandy and reports that the storm had little or no impact on the upland area of Margaret’s Creek where the containment cell would be located. Moreover, although other non-contaminated material used to construct the Seawall (such as construction debris) was washed from its location, the large slag pots remained intact and largely in place. Thus, the recent storm has confirmed EPA’s conclusion that remedies including on-site containment would be fully protective of human health and the environment.

Comment No. 4. – EPA Correctly Concluded that Operation and Maintenance of an On-Site Containment Area Does Not Impact the Protectiveness of an On-Site Containment Remedy.

Although on-site containment remedies may require future operation and maintenance, the inclusion of operation and maintenance requirements is routine for remedies at Superfund Sites, especially those involving lead contamination. For that reason, EPA did not conclude that remedies including operation and maintenance would fail to protect human health and the environment, or fail to provide long-term effectiveness and permanence. *See Revised FS at 4-50.* Operation and maintenance is not of particular concern for the Seawall and Margaret's Creek portion of the Site because the property is owned by a municipal entity, Old Bridge Township, which will be around for a long time and has a vested interest in protecting the health and safety of its residents. Moreover, because Old Bridge is a PRP at the Site, the opportunity to perform operation and maintenance gives it a cost-effective way to contribute to the Site remedy. The other alternative for Old Bridge would be to meet its entire obligation as a PRP through a cash payment, which it can ill afford.

Comment No. 5. – Remedies Including On-Site Containment Comply with All ARARs.

The on-site containment remedies (Alternatives 3 – 5) considered in the Revised FS all comply with applicable or relevant and appropriate requirements ("ARARs") as that term is used in CFR § 300.430(f)(1)(ii)(B) essentially to the same degree as the total off-site remedy selected by EPA. As EPA noted in the Revised FS:

Alternatives 3 – 5 would comply with chemical-specific ARARs through various remedial activities.... Alternatives 2 through 5 would comply with action-specific ARARs by implementing health and safety measures during the remedial action, and by

meeting regulatory requirements necessary for remedy implementation.

See Revised FS at 4-50. These same findings were echoed in EPA's Public Meeting Presentation, which stated that Alternatives 3 – 5 all "meet[] criteria" for compliance with ARARs. (Ex. R.)

EPA's conclusion that remedies including on-site containment would comply with all ARARs is not surprising. On-site containment of lead-impacted materials is a common approach used at many sites throughout the nation. For example, EPA concluded that on-site containment met all relevant ARARs at numerous other lead Superfund Sites as described in the Advanced GeoServices On-Site Containment Cell Technical Report (Ex. A).

Comment No. 6. – Remedies Including On-Site Containment Satisfy the Criteria for Long-Term Effectiveness and Permanence.

EPA correctly found that remedies including on-site containment satisfy the NCP criteria for long-term effectiveness and permanence set forth at 40 C.F.R. § 300.430(e)(9)(iii)(C) essentially to the same degree as the total off-site remedy selected by EPA. As EPA stated in the Revised FS:

Alternatives 2 through 5 would remove the contaminated materials from the current unprotected locations and **would achieve long-term effectiveness and permanence**. Alternatives 3 through 5 would achieve long-term effectiveness through a combination of removal, off-site disposal, on-site containment and capping and would be permanent if long-term site controls are maintained.

Revised FS at 4-50 (emphasis added).

As discussed in the Advanced GeoServices On-Site Containment Cell Technical Report (Ex. A), this is consistent with EPA's findings at numerous other lead Superfund Sites, where EPA has found that containment of lead is an effective and permanent remedy over the long

term. As described in Comment No. 4 above, operation and maintenance of such a remedy is routine and can be performed by Old Bridge, the owner of the property. The cost of operation and maintenance of an on-site containment unit is fully accounted for in the Revised FS. For these reasons, as well as the reasons stated in the Revised FS, EPA is correct that on-site containment remedy alternatives satisfy the NCP criteria for long-term effectiveness and permanence.

Comment No. 7. – Remedies Including On-Site Containment Meet Toxicity/Volume/Mobility Reduction Objectives To The Same Degree As The Total Off-Site Disposal Remedy Preferred by EPA.

EPA correctly found that both the on-site and off-site disposal remedies it considered all equally meet the toxicity, volume and mobility reduction objectives of the NCP essentially to the same degree. According to EPA, none of these alternatives “reduce toxicity or volume through treatment on-site; however, off-site disposal, on-site containment and capping under Alternatives 2 through 5 would reduce the mobility of contaminants.” *Revised FS at 4-50 – 4-51*. In other words, off-site containment provides no different reduction in toxicity, volume or mobility than on-site containment.

Comment No. 8. – Remedies Including On-Site Containment Are Fully Implementable.

EPA is correct that all on-site and off-site remedies are implementable. As EPA stated in the Revised FS:

Alternatives 2 through 5 would be technically implementable and would use conventional construction equipment, although there would be several technical challenges related to dredging and dewatering the sediment, segregating the slag, accessing work areas, siting of on-site containment cells, capping under water, and transportation logistics. Alternatives 2 through 5 would also

encounter some technical challenges with regard to coastal restoration. Additionally, Alternatives 3 through 5 also could face potential issues due to settlement of the ground following placement of contaminated material in the containment cells.

Revised FS at 4-51.

The last sentence concerning “potential” settlement of the ground has no basis or support in the Administrative Record for this Site or at other Superfund Sites, and EPA rightfully does not appear to rely on this potential issue to conclude that on-site containment is any less implementable than off-site disposal. Rather, it is relevant only to the cost of on-site containment and all of the potential contingent cost for addressing such remote possibilities has already been added to EPA’s cost estimates for the remedial alternatives that include on-site containment. (See Comment 10 below.) Thus, implementability is essentially the same for the on-site and off-site disposal remedies.

Comment No. 9. – EPA Has Significantly Under-Scoped The Volume and Cost of Material That Would Have to Be Shipped to a Hazardous Waste Landfill Under the Total Off-Site Disposal Alternative.

EPA may have significantly underestimated the cost and impact of off-site disposal from the Site. Under the EPA’s preferred alternative, all material that fails TCLP must be shipped to a hazardous waste facility for treatment and disposal. EPA has set a PRG of 400 mg/kg lead (apparently as a not-to-exceed value). EPA has concluded that only 20% of the material that exceeds this PRG (and must be sent off-site under EPA’s preferred remedy) would fail TCLP. However, according to the Advanced GeoServices TCLP Technical Report, attached as Exhibit “D,” the available TCLP data obtained by EPA indicates that, in reality, all of the material with above 400 mg/kg lead would fail TCLP and would potentially be considered hazardous waste that must be shipped to a permitted Subtitle C facility for treatment and disposal. Since the

nearest hazardous waste facilities are in either Pittsburgh, PA or Buffalo, NY, this means that trucks leaving the Site would have to travel a minimum of 680 miles per load. For EPA's selected remedy, Alternative 2, Advanced GeoServices calculates that the increase in the remedy capital cost would be \$17 million bringing the total cost from \$78.8 million to almost \$103 million when contingencies, design, and management costs are included. This difference has a major impact on the relative cost-effectiveness of the total off-site disposal remedy as compared to on-site containment. Moreover, this difference significantly increases the adverse short-term impacts of the off-site disposal remedy (See Comment No. 19 below.) Among other things, as compared to on-site containment, off-site disposal would drastically increase the risk of traffic accidents and injuries across multiple states. EPA should re-evaluate the costs and impacts of its preferred remedy in light of the actual data it collected. As the NRRB correctly noted in its July 5, 2012 Recommendations memo, the difference between the equally protective remedies of off-site disposal and on-site containment is already nearly \$30 million. (*See* Ex. N at 7.)

In order to have an "apples to apples" comparison of on-site containment versus off-site disposal costs for the unique materials at this Site, NL asked Advanced GeoServices to analyze the cost of disposal of a cubic yard of slag under each approach. As set forth in the Advanced GeoServices Slag Disposal Cost Technical Report, attached as Exhibit "H," it costs twice as much to ship the slag to an off-site disposal facility versus safely containing it on-site in a properly designed containment cell located in the Margaret's Creek upland area.

When the true costs of off-site disposal are considered, the difference in costs between the on-site containment and off-site disposal remedies is closer to \$50 million. For EPA to select a remedy that is \$30 million to \$50 million more expensive than another remedy that is just as effective and protective of human health and the environment (and which would have

significantly less negative impact to the local community) would be arbitrary, inappropriate, and inconsistent with the NCP.

Comment No. 10. – EPA has Overstated the Cost of On-Site Containment by Incorrectly Including Costs for Ground Improvements When No Such Measures Are Likely to be Required.

Although EPA has understated the cost of off-site disposal, EPA has added remote and contingent costs to the on-site containment remedial alternative, including an approximately \$750,000 per-acre addition to the cost of the containment cells to account for the entirely unsupported notion that “possible issues involving ground settlement” could affect the cost of the remedy. This amount adds up to millions of dollars when applied to the on-site containment cell. In the Revised FS, Section 2.7.5.1, EPA provides a brief discussion on the need for ground improvement in order to construct an on-site containment cell, stating: “Additionally, ground improvement techniques may have to be used prior to construction of the structure (*i.e. the containment cell*) in order to mitigate any settlement that would likely occur subsequent to the construction.” *Revised FS at 2-29*. In the PRAP, EPA makes a stronger statement, saying: “Additionally Alternatives 3 through 5 also could face potential issues due to settlement of the ground following placement of contaminated material in the containment cells.” *PRAP at 14*. To mitigate this potential effect, EPA includes a cost of \$776,867.15 per acre. For Alternative 5, this adds over \$3.88 million to the estimated cost of the remedy for the proposed 1-acre cell in the Western Jetty and 4-acre cell in the upland portion of Margaret’s Creek. Based on the boring logs for the upland area, EPA’s consultant says that foundation settlement on the order of 4 to 8 inches for a 15-foot high containment cell is indicated based upon review of boring logs, and that it is very likely that the settlement may not be uniform. However, in the Advanced GeoServices

On-Site Containment Cell Technical Report (Ex. A), Advanced GeoServices, also reviewed the boring logs in the upland portion of Margaret's Creek and concluded that in a properly designed containment cell settlement that requires any repair is highly unlikely. Given the results of the standard penetration tests and the description of the subsoils, potential settlement, if any occurred at all, would be more on the order of 2 to 3 inches. (See Exhibit A.) Such minimal settlement, if it even occurred, would not require extensive or expensive repairs. (*Id.*) Thus, not only is it highly unlikely settlement would occur requiring any repair, the potential cost of such repair would be far less than the estimates provided by EPA. Consequently, the millions of dollars EPA added to the cost of the on-site containment remedies considered in the Revised FS for the Site is an arbitrary number and should be removed from the decision documents.

Comment No. 11. – Designation of the Site Source Materials as a “Principal Threat Waste” is Erroneous, Misleading and is Arbitrary and Capricious.

EPA has erroneously asserted that all of the material EPA recommends for removal (i.e., all slag, all battery casings and all soil/sediment containing lead at levels greater than 400 mg/kg) constitutes “principal threat waste.” EPA appears to use this “principal threat waste” designation to further support its preference of the total off-site disposal alternative over alternatives involving on-site containment. However, EPA's analysis in the Revised FS fails to follow the standard set forth in its own guidance document titled “*A Guide to Principal Threat and Low Level Threat Wastes*” (OSWER document #9380.3-06FS dated November 1991), attached as Exhibit “O,” and fails to accurately characterize the risks associated with the Site material recommended for removal.

According to EPA's guidance, “principal threat wastes” are “those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or

would present a significant risk to human health or the environment should exposure occur.” (Ex. O at 2.) However, EPA’s own data and risk assessments show that the slag source material at this Site does not meet any of these factors. (Attached as Exhibit “F,” is Advanced GeoServices’s Principal Threat Waste Technical Report.) Most obviously, EPA concedes throughout the decision documents that, unlike true “principal threat waste,” slag and impacted sediments can indeed be “reliably contained” either on-site or off-site.

Moreover, according to Advanced GeoServices’s review of the Administrative Record, EPA’s principal threat waste analysis fails to take into account that (1) the Site is used for recreational, not residential, use; (2) the risks at the Site even prior to any remediation are low; (3) the high concentrations of lead that could make the source material a significant risk are bound up inside the massive solid 450 pound slag pots, and the only real “mobility” of lead from the slag occurs through mechanical weathering as the slag sits in the water and is subjected to wave action – a mechanism that would be eliminated through containment of the material in an upland cell; (4) lead at levels above 400 mg/kg routinely is remediated at sites throughout the nation using on-site containment remedies, and (5) EPA’s preferred remedy is just another containment remedy (off-site instead of on-site containment) and in no way reduces the toxicity or mobility of the source materials as compared to an on-site containment remedy. (See Exhibits E, F.) EPA’s reference to this material as a “principal threat waste” is simply erroneous and not supported by EPA’s own findings. It is difficult to understand why EPA would exaggerate the risk associated with the unique source materials at this Site by calling it a “principal threat waste” unless EPA intended to bolster its selection of an off-site remedy that is not otherwise justified by the data and the analysis required by CERCLA and the NCP. For these reasons, NL

believes all references to “principal threat waste” should be removed from the remedy decision documents.

Comment No. 12. – EPA’s Implication that the Slag Poses a Leaching Risk if Contained On-Site is Erroneous and Misleading.

EPA’s assertion that placement of slag into an upland on-site containment cell would create a “potential” risk for lead to leach into the environment is erroneous and misleading. Again, EPA appears to use this idea of “leaching” to further support its preference of the total off-site disposal alternative over alternatives involving on-site containment. This appears to be nothing more than a post hoc attempt to support a remedy preference questioned by the NRRB as not being cost-effective. EPA previously acknowledged that potential leaching risks were *not* a driver of the remedy selection. That acknowledgment was appropriate because much of the sampling data underlying EPA’s leaching analysis was improperly collected (as EPA has admitted) and there is no evidence that any significant leaching is occurring even under current, unprotected, Site conditions. (See Comments 13 and 14, below, concerning the lack of data establishing that lead is leaching to surface or groundwater in any measurable quantity).

This Site involves source materials that are not highly mobile or highly “leachable” to begin with. As set forth more fully in the Advanced GeoServices Lead Mobility Technical Report (Ex. E) and in Comments 13 and 14 below, there is presently no reliable data showing that the slag now at the Site, which has been uncontrolled and sitting in the water subjected to wave action for four decades, has contaminated either groundwater or surface water. Moreover, as EPA’s own contractor noted, when crushed slag particles were subjected to the SPLP leachate test (intended to mimic seawater) and the DIW (de-ionized water) leachate tests, lead did not leach at levels that were even detectable. (See Ex. E.) Although EPA’s contractor was able to

obtain leachate samples that exceeded the drinking water standard by artificially exposing a drilled slag core to a very small volume of water in a “semi-dynamic leach test,” that amount of leachate would be entirely undetectable in the volume of water actually available at the Site (which is millions of times greater than the volume used in the leachate tests). (*See Ex. E.*) Any amount of lead released at that level that leached into surface water would be so dilute as to be insignificant (as demonstrated by the surface water sampling) and would have no negative impacts to surface water or to groundwater in an area where groundwater cannot be used for, nor is classified as, drinking water. Moreover, any small amount of lead that did leach from source material would be readily reabsorbed onto nearby particles of soil or sediment (or containment cell barrier materials) and become immobilized. In other words, the source material at the Site simply is not leachable to any significant degree. (*See Ex. E.*)

As more fully described in the Advanced GeoServices Lead Mobility Technical Report (Ex. E.) the primary (if not only) transport mechanism of lead in the slag to soils and sediments at the Site is mechanical weathering by wave action over an extended period of time. That transport mechanism, and indeed any possible “leaching” from that material, can be completely interrupted by simply removing the slag from the water and placing it in a secure containment unit. Once that is accomplished, the slag no longer would be subject to mechanical weathering and lead in the slag would be effectively immobile. Thus, by placing slag, as well as impacted soils and sediments, in a properly designed on-site containment unit, hazardous substances will be rendered completely immobile.

As a matter of fact, EPA’s preferred off-site disposal remedy is just another containment remedy. If containment can be designed appropriately to render the material immobile at an off-site location, it can also be designed appropriately to contain the material on-site. For these

reasons any mention of leachability of the Site materials is simply misleading and references to leaching should be removed from the decision documents or placed in an appropriate context.

Comment No. 13. – EPA’s Surface Water Sampling Was Flawed and Failed to Follow Basic Sampling Guidelines.

The surface water sampling results relied upon by EPA are flawed because EPA failed to use appropriate techniques to avoid false positive results. NL has previously pointed out the flaws in EPA’s sampling and has previously offered to perform new sampling to replace that flawed data with reliable data. However, EPA put off NL’s request by implying that the flawed data was not driving the remedy selection. Specifically, in February 2012, Advanced GeoServices on behalf of NL submitted comments to EPA on the RI, which contained a section explaining the problems with EPA’s sampling. Those comments together with Advanced GeoServices’s analysis of information on surface water sampling available after that date are summarized in the Advanced GeoServices Lead Mobility Technical Report (Ex. E). Advanced GeoServices concludes that to date there is simply no accurate and representative data showing that the actual Site source materials are leaching to surface water at the Site.

Despite these concerns, EPA has continued to state in decision documents made available to the public that slag has contaminated surface water, without fully informing the public of the issues that render its sampling unreliable. EPA’s refusal to allow NL to take new tests using procedures that would avoid false positives, and its failure to inform the public of the issues with the previous sampling, are likely misleading the public into believing that lead is far more mobile in the environment than it actually is. Presenting misleading and flawed information is not appropriate, but to the extent EPA relied on this flawed information for any remedy decision, that remedy decision is arbitrary and capricious.

Comment No. 14. — EPA's Groundwater Sampling Was Flawed and Failed to Follow Basic Guidelines.

The groundwater sampling results relied upon by EPA are flawed because EPA failed to use appropriate techniques to avoid false positive results. NL has previously pointed out the flaws in EPA's sampling and has previously offered to perform new sampling in the same wells to replace that flawed data with reliable data. Specifically, in February 2012, Advanced GeoServices on behalf of NL submitted detailed comments to EPA on the RI, which contained a section explaining the problems with the groundwater sampling. Those comments and the basis for Advanced GeoServices's conclusion that the data is flawed are set out in the Advanced GeoServices Lead Mobility Technical Report (Ex. E).

In response, the Remedial Project Manager for the Site, Tanya Mitchell, sent an email which stated:

The analytical results demonstrate that there is an impact to GW. However, these results could be an anomaly or a false positive as you suggest. At this time, EPA does not believe the GW is a risk driver in the absence of the slag.

Since, there is sufficient GW data to complete the RI/FS, the remedy will be managed with this anomaly in mind and EPA will continue to evaluate the GW conditions. Thus, there does not appear to be an advantage to collecting additional GW samples at this time.

(July 13, 2012 email from Tanya Mitchell to Christopher Reitman, attached as Exhibit "M.")

Although EPA has admitted that its groundwater sampling data may be flawed and may show a false positive, it has denied NL the ability to conduct additional sampling using the correct protocols that would conclusively establish whether the groundwater has been impacted by slag and has not itself conducted that sampling. EPA has also continued to state in decision documents made available to the public that slag has contaminated the groundwater, without informing the public that

these tests were taken incorrectly and may actually be false positives. EPA's refusal to allow NL to take new tests using procedures that will avoid false positives, and its failure to inform the public of the issues with the previous sampling, are likely misleading the public into believing that lead is far more mobile in the environment than it actually is. Advanced GeoServices believes correctly performed sampling would establish that lead from Site source materials is not impacting groundwater, based on the lack of acidic conditions and the low mobility of lead in general despite the fact that those materials have been uncontrolled at the Site for over 40 years. (See Ex. E.) Presenting misleading and flawed information is not appropriate, but to the extent EPA relied on this flawed information for any remedy decision, that decision would then be arbitrary and capricious.

Comment No. 15. – The Ability of the State and Community to Make Informed Comments Has Been Impeded by EPA's Reliance On Flawed Data and Misleading Information

NL understands from EPA Region II's September 17, 2012 Response to the Recommendations of the NRRB (which asked why the Region was preferring an off-site remedy that was \$30 million more expensive than equally protective alternatives involving on-site containment) that the State and community support on off-site remedy. *Region II Response to NRRB at 10-11*. But EPA has given the State and the community an inaccurate picture of the risks posed by this material. The State and community have thus been robbed of the opportunity to make an informed decision as to which remedy is most appropriate given the actual risks posed by the Site.

As explained in numerous Comments above, EPA has repeatedly stated that groundwater and surface water at the Site are contaminated by Site materials. EPA has led the public to believe that the Site source materials "leach" and that on-site containment would somehow be

less protective. EPA has also referred to the source material at the Site as “principal threat waste,” which, by definition is waste that is so highly mobile it cannot be adequately contained or so toxic that it would pose a significant threat if exposed. (*See* Ex. F.) Here, the risks at the Site are currently very low and largely hypothetical even with all of the material wholly uncontained and sitting in the water for over 40 years. EPA’s own findings establish that the material can be safely contained. *Revised FS at 4-50 to 4-51*. And in fact the preferred remedy itself is a containment remedy (but at an off-site location).

In evaluating the State’s and community’s comments on the remedial alternatives, EPA must bear in mind that support for the off-site disposal remedy may be based on the flawed data and misleading statements made by EPA in the Administrative Record.

Comment No. 16. – The Region Should Consider A Remedy that Includes the Use of Slag Containment Features to Increase Storm Protectiveness and Erosion Control.

The slag located at the Seawall in Laurence Harbor was placed there as part of a project to prevent beach erosion and protect property behind the Seawall from storms. The propriety and effectiveness of its use for that purpose was validated by the original approval of the USACE, the State, and Old Bridge. See Comment 23 concerning Site History. Indeed, the slag has proven over some 40 years to be a stable and effective structural element of the Seawall. The recent severe storms showed that the Seawall was not enough to stop the storm surge. Nevertheless, although certain areas of the Seawall were damaged, the larger and heavier pieces of material, including the slag pots, stayed intact and largely in place. In the wake of recent severe storms, there is a new and urgent need for coastal restoration and for features that will provide protection from storms. There are viable designs and construction methods that could

incorporate the valuable features of the slag into the site remedy while at the same time providing an added benefit of preventing it from mechanically eroding.

At significant expense and with the blessing of EPA, NL performed an Engineering Evaluation/ Cost Analysis (“EE/CA”), attached as Exhibit “J,” which proposed a remedial alternative whereby the risks posed by the slag would be addressed by encapsulating it immediately behind the Seawall, which would then be rebuilt – the “macro-encapsulation” approach. (Ex. J.) Old Bridge supported that project. Despite the EE/CA, EPA did not include in the Revised FS an alternative that included the encapsulation of material to buttress the Seawall. In light of the recent severe storms, EPA should at least evaluate whether the slag material could be moved, protected and contained (using encasement in concrete for example) to help construct or buttress a new Seawall or berm that would provide additional storm protectiveness to the area behind the Seawall. Such a project would have numerous positive effects, including not only providing additional protection from storms, but also drastically reducing the adverse short-term impacts of the EPA’s current preferred remedy (described in Comment 19 below). EPA should also consider whether slag from the Western Jetty can be encapsulated or otherwise used as part of a storm-protectiveness project on the Western Jetty property, and/or could be used to make that property more suitable for development consistent with the Borough of Sayreville’s concept to commercially develop that property.

NL reiterates that it is willing to play an active and constructive role in developing remedial alternatives at the Site that are fully protective of human health and the environment while also using the source material (which was brought to the Site by third parties because it had attributes that made it useful for constructing storm-protection features) for a useful purpose rather than simply dumping it in a landfill at significant extra cost without any corresponding increase in

protectiveness. The additional benefits provided by storm-protection features make such projects more “effective” than the massively more expensive remedy of off-site removal, which ultimately simply shifts the problem to someone else and wastes limited landfill resources. EPA’s refusal to even consider the feasibility of such projects is arbitrary and capricious.

Comment No. 17. – EPA Has Failed to Appropriately Examine *In Situ* Treatments That Would Potentially Minimize the Volume and Toxicity of Soils and Sediments.

EPA has apparently rejected *in-situ* treatment technologies to reduce volume, toxicity or mobility of contaminated soils or sediments, such as soil washing or mechanical separation techniques, because a preliminary “sieving” analysis conducted by EPA’s contractor showed that lead slag particles were present across different grades of coarseness in the sand. *Region II Response to NRRB at 6*. In other words, because there were slag particles in the coarse fraction, the medium fraction, and the fine fraction of the sands analyzed, EPA apparently assumed nothing could be done to reduce the amount of lead impacted sand and all of it must be contained on-site or shipped off-site. When the NRRB raised the concern that mechanical separation techniques were not being seriously considered, EPA Region II responded:

Mechanical size separation technology was not considered because the contamination exists in both the fine fraction as well as the coarse fraction, as indicated in the fractionation results during the characterization study of the slag and contaminated sediment.

Id.

EPA failed to consider whether other mechanical separation techniques (such as “gravity separation,” “magnetic separation” or “soil washing” techniques) could be used to reduce the volume of impacted soils and sediments that must be addressed at the Site.

Attached at Exhibit “G” is the Advanced GeoServices Separation Technologies Technical Report, which includes a letter from Carl Seward of ART Engineering, LLC explaining how Mr.

Seward has successfully implemented soil washing procedures at other metals sites in this region. (See also the letter of recommendation ART Engineering received from Ronald Naman, an EPA Region II Remedial Project Manager, based on ART Engineering's implementation of a similar program at another site in New Jersey, which is attached to Ex. G.) Mr. Seward has reviewed the Schnabel report relied upon by EPA and other Site information and has concluded that this Site would actually be a prime candidate for a soil washing treatment program that could significantly reduce the volume of material that must be addressed. NL suggests that before a ROD is issued, EPA and NL should cooperate on a pilot study to determine whether a soil washing program would be beneficial. Such a remedy would be consistent with CERCLA's mandate that remedies including on-site treatment be preferred over off-site disposal remedies. 42 U.S.C. § 9621(b). Such a technique could substantially reduce the volume of material that must be removed and contained/sent off-site for disposal as well as the amount of clean material that would have to be brought in as replacement material. This could substantially reduce the cost of all remedial alternatives considered for the Site.

Comment No. 18. – On-Site Treatment Should be Used For Any Hazardous Material That is Shipped for Off-Site Disposal.

In the Revised FS and the PRAP, EPA has incorrectly required transport of material from the Site as hazardous waste and treatment of the material as hazardous waste at a permitted Subtitle C facility followed by disposal, greatly increasing the cost and time to implement the remedy. Any material that would be transported off-site and out of state for disposal should instead be treated on-site in situ within the same Area of Contamination ("AOC")/Corrective Action Management Unit ("CAMU") to remove the toxicity characteristic, which would then allow for disposal at a local Subtitle D facility.

In Section 2.2.5 of the Revised FS, EPA categorized the site materials as D008, a RCRA characteristic waste that fails the TCLP regulatory standard for lead. Later in Section 2.7.7, in its evaluation and screening of implementable technologies, EPA considered ex-situ chemical treatment to reduce the mobility of lead as an implementable technology and stated “under this process option, contaminated materials from all areas of the site will excavated/dredged and treated in designated remediation target areas and then either disposed of at off-site facilities, placed in the containment structures on-site or consolidated and placed back in the excavated/dredged areas.” *Revised FS at 2-32 to 2-33*. However, in the following section, Section 2.7.8.2, EPA apparently assumes that any material that is TCLP hazardous must be disposed of in a Subtitle C landfill or be treated at an off-site facility prior to disposal. *Revised FS at 2-34*.

To the extent EPA has simply ruled out on-site treatment of material that must be sent to a landfill to remove the toxicity characteristic prior to transport and disposal, it has made an error. Failing to treat material before shipping it to off-site landfills would ignore routine practice at Superfund sites in New Jersey and elsewhere in the United States. (See attached as Exhibit “T” the Advanced GeoServices On-Site Treatment Technical Report.) This approach is also in direct conflict with CERCLA, which indicates a preference for such treatment to occur before removal from a site. Section 9621(b)(1) of CERCLA states: “The offsite transport and disposal of hazardous substances or contaminated materials without such treatment [i.e. treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants] should be the least favored alternative remedial action where practicable treatment technologies are available.” 42 U.S.C. § 9621(b). On-site treatment of any material that must otherwise be sent off-site for treatment and disposal in another state

would significantly reduce the cost of treatment, transport and disposal as well as the time of the remediation since there are a limited number of hazardous waste transport trucks available and the distance that the trucks would be required to travel would be greatly reduced.

On-site treatment would significantly reduce costs because it would allow for disposal at a Subtitle D facility locally within the state of New Jersey. As the material would now be non-hazardous, no further treatment would be required to meet land disposal restrictions prior to disposal at a Subtitle D facility. As presented in the Advanced GeoServices On-Site Treatment Technical Report (Ex. I), the transportation and disposal facility costs of a local Subtitle D facility are less than one half the cost transport and disposal to the nearest Subtitle C facility (in Yukon, PA). Allowing on-site treatment could also significantly reduce the negative short term impacts at the site (discussed in Comment 19 below), including a decrease by almost two thirds of the number of truck miles. (See Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report, attached as Exhibit "C.")

Furthermore, on-site treatment may have positive effects in terms of the amount of time required to complete the remediation project. As explained more fully in Comment 19 and in the Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report (Ex. C), the amount of material a Subtitle C facility could accept in a day is. This could result in a backlog that delays the project. Treating material on-site in a secure, controlled area to allow it to be disposed of at a Subtitle D facility would permit use of multiple disposal facilities, reducing the potential for delay caused by a disposal backlog at any particular facility. Therefore, EPA should revise its decision documents to allow for on-site treatment to the extent any materials must be disposed off-site, which will significantly reduce costs and negative short term impacts.

Comment No. 19. – EPA’s Preferred Off-Site Disposal Remedy Will Have Substantial Negative Short-Term Impacts Not Adequately Considered by EPA.

The Revised FS incorrectly implies that the short-term impacts of the off-site remedies and the on-site remedies are equivalent. The Revised FS states that although off-site remedies would involve more truck traffic, remedies involving on-site containment would involve more construction work at the Site. *Revised FS at 4-51*. These are not the same thing. The location of the proposed on-site containment unit has served in the recent past primarily as a dumping ground. The only persons with access to that area of the Site are utility workers. The property adjacent to the Western Jetty is vacant, currently subject to a tax lien, and is not presently used by anyone. Increased construction in such areas would have little, if any, impact on the community. The total off-site remedy (Alternative 2), on the other hand, would have significant negative short-term impacts on the community and the environment, by inundating the area with large trucks that would adversely impact local infrastructure, cause traffic congestion, use thousands of gallons of fossil fuel, and drastically increase the risk of accidents and injuries on local roads.

The magnitude of off-site trucking would have substantial detrimental impacts to the community and the environment. Under EPA’s preferred total off-site remedy, the material sent off-site would have to be transported hundreds of miles to disposal facilities located in Yukon, Pennsylvania and/or Model City, New York. Trucks would then have to bring in clean materials. Advanced GeoServices examined the short term impacts of EPA’s preferred alternative and presents its analysis in the Advanced GeoServices Negative Short Term Impacts Technical Report (Ex. C). Based on the quantity of materials that must be taken off-Site for disposal and the quantity of clean materials brought to restore the Site, Advanced GeoServices estimates that industrial hazardous waste trucks will travel almost 6.6 million miles to perform this alternative.

These thousands of trucks will have to line up and be staged on local roads near the Site to receive materials for off-Site disposal or wait to unload clean materials. The main thoroughfare that would be utilized (Route 35) is not amenable for the number of trucks that would be required and has single lane bridges in close proximity to the Site. Advanced GeoServices estimates that the emissions associated with this alternative are 25,040,250 lbs carbon dioxide equivalents. See Comment 20 below for additional information on the lack of sustainability of the preferred remedy.

As more fully described in the Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report (Ex. C), there are a host of additional significant negative impacts that arise from all of the truck traffic required to implement EPA's preferred remedy. Traffic accidents will be greatly increased as shown by statistics that trucks are 8 times more prone to accidents involving cars compared to single trucks or other vehicles, *Analysis of Truck Accident Reports in Work Zones in New Jersey* (August 1997). Traffic congestion, delays, and additional road maintenance needs resulting from wear and tear on roads from heavy trucks will impact the local businesses and residents of the community. These factors also could have a substantial impact on extending the project schedule. The thousands of extra truck trips would also increase noise, dust and exhaust emission pollution, all of which would detrimentally impact local businesses and quality of life of residents of the community. The lack of capacity of the receiving landfill for these very large volumes is also likely to significantly increase the time it will take to complete the project.

On the other hand, any potential negative impacts mentioned by EPA concerning the on-site remedies can all be minimized and managed by implementing proper construction methods,

planning, security, and site control measures. These on-site activities will essentially be performed in a controlled and restricted area and will have far fewer short term impacts.

The short term negative impacts from the EPA's preferred remedy compared to the on-site containment remedies are simply not equal. EPA's refusal to properly consider those impacts in the Revised FS is arbitrary and capricious.

Comment No. 20. – EPA has Understated the Lack of “Sustainability” in the All-Off-Site Disposal Alternative.

Selection of Alternative 2 is not consistent with EPA's Green Remediation policy. EPA did not consider the effects of increased carbon emissions associated with this alternative nor did it factor in the cost impact of its mitigation measures. Advanced GeoServices performed such an analysis in the Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report (Ex. C) and concluded that EPA's preferred off-site disposal remedy is not sustainable because of the thousands and thousands of heavy truckloads that will be transported millions of miles over public roads. Although EPA admits that off-site disposal is less sustainable than other alternatives, it implies that this concern has been addressed by a vague promise to consider the use of fuel efficient vehicles (for transporting slag) and biofuels. If such changes are actually going to be made, then they should be considered in the cost estimates for the Site. Doing so will show that Alternative 2 actually is even less cost-effective than it already appears.

Otherwise, if EPA is not going to actually include such measures in the price, it should simply admit that Alternative 2 is by far the least environmentally sustainable remedy and leave it at that. In addition to adversely impacting the roads, Advanced GeoServices calculates that Alternative 2 has the highest estimated greenhouse gas emissions due to high fuel consumption --

almost 10 times higher than if the material is contained on-site. (Ex. C.) Nowhere in the decision documents does EPA provide any calculations to show the magnitude of the difference. According to Advanced GeoServices, the mitigating measures that EPA mentions in the Feasibility Study such as using biodiesel in lieu of conventional diesel and electricity from 100% renewable sources are not realistic or reasonable. The closest fueling station is over 21 miles from the Site. Nor has the cost of these mitigating factors been included in the cost estimates. Biodiesel is at least 6% more expensive than conventional diesel for the lowest blend and 42% more expensive for the higher percentage blends. Biodiesel is also less efficient and does not provide the same level of motive power as conventional diesel. Consequently more fuel is required to accomplish the same task. According to Advanced GeoServices's analysis, use of biodiesel could add up to \$5 million to the cost of Alternative 2 for the transportation portion of the project alone. (Ex. C, at Att. C-4.) When factoring in the cost of fuel into the remaining operations such as excavation and treatment plus the added cost of obtaining all electricity from renewable sources, Advanced GeoServices estimates that this increased cost could easily double to add about 10% to the overall cost of the remedy. (Ex. C.)

EPA should correct its misstatements in the decision documents and admit that selection of an on-site containment alternative is far more consistent with EPA's sustainability objectives than Alternative 2.

Comment No. 21. – EPA Should Adopt a Risk-Based PRG for Lead That is Based on an Appropriate Depth.

EPA has identified a "risk based" PRG of 400 mg/kg lead which reflects the volumes to be removed in the sediment for the Seawall Sector and the Western Jetty Sector. *PRAP, Table 1.* The goal is apparently based on two potential exposures, the exposure risks to a recreating child

on the beach and the exposure risks to a semi-palmated plover over its 10-acre foraging area. However, EPA has not identified any risks that relate to soils or sediments that are not located at the surface. Other sites in the region have used a different PRG for contaminants at depth. At the Horseshoe Road Superfund Site, for example, which is located on the banks of the Raritan River just a few miles away from the Site, EPA used a different PRG for arsenic below two feet in depth. EPA should similarly adopt a PRG for lead at depth that reflects the realities of the exposure risk for containments at depth and the diverse nature of the various areas of the Site. Lead-impacted soils or sediments located below 12 inches, for example, pose no human health exposure risk and are not accessible to birds. Accordingly, at the very least, a higher PRG should be defined for soils and sediments at certain depths depending on the particular area of the Site.

Comment No. 22. – EPA’s Revised FS Should Include a Phased/OU Alternative Focusing First on Removal of Primary Source Material.

For more than a year, NL and Old Bridge Township have been discussing a phased or operable unit (“OU”) type of approach, working closely to develop a proposed cleanup plan that is fully protective of public health and the environment, while avoiding unnecessary cost, disturbance, and detrimental impact on the community. NL and Old Bridge had several meetings with EPA about this approach. NL made the suggestion of a phased approach in its comments to the NRRB. (Attached as Exhibit “L” are NL’s March 12, 2012 Comments to the NRRB.) Also, the alternatives evaluated in NL’s EE/CA all were based upon the phased approach. (*See* Ex. J.) Nevertheless, none of the alternatives evaluated in the Revised FS considered any type of phased/primary source removal alternative. However, this type of alternative is the right approach for the Site.

The most immediate goal should be to address issues in the publicly-owned, publicly-accessed area of the Site, which is the portion of the Site located in Old Bridge Township. Under any removal alternative ultimately selected by EPA, the source materials (i.e., the slag pots and battery casings) and immediately adjacent sediment and soil most impacted by the slag and casings in the Old Bridge portion of the Site will have to be removed. Moreover, those source materials and immediately impacted soil/sediment drive the majority of the risk that EPA has identified as existing at the Site. It makes sense to focus first on the removal activities that will have the greatest impact in reducing risks at the Site, particularly as both public and private financial resources to address Site issues are limited. The alternatives described in the EE/CA are first phase measures designed to do just that. Once the first phase is completed, a further evaluation can be performed to determine whether, and if so what, additional risks remain and whether additional remediation is necessary. The phased approach articulated in the EE/CA has the additional benefit of allowing the public area of the Site, including the Old Bridge beach and park areas, to be reopened to the public as quickly as possible.

Comment No. 23. – The Discussion of Site History in the Decision Documents is Incomplete And Should be Expanded To Include All Relevant Facts.

Although EPA has identified NL as a PRP with respect to the Site, that identification is based only upon an allegation that at least some of the slag present at the Site came from NL's nearby Perth Amboy facility. But NL was not involved with the design or responsible for the construction of the Seawall or the construction/renovation of the Western Jetty. EPA's current Site History information in the decision documents is arbitrarily incomplete, and NL asks that EPA revise those documents to present the complete facts as set forth below.

Federal and State Cooperative Hurricane and Shore Protection Project

In the 1940s and 1950s, Laurence Harbor was a popular shore destination. Cottages, used primarily as vacation homes, lined the shoreline. However, a series of strong storms in the 1950s (including two hurricanes in 1954) eroded the beach and destroyed most of the cottages.

In 1955, the New Jersey Department of Conservation and Economic Development (“NJDCED”)⁴ applied to the USACE requesting that a cooperative beach erosion study be conducted for the shorelines along the Raritan Bay and Sandy Hook Bay. The USACE undertook the investigation and issued a report in 1961, which documented the condition of the shoreline at that time, provided information on the community support for improvements to the shoreline area, and proposed plans for improvements. (See attached as Exhibit “K-1,” USACE’s 1961 Report) The USACE’s report observed:

The problem in the study area is a combination of shore erosion from wave attack and inundation from storm tides. This has resulted in loss of life, hardship to hundreds of families evacuated during times of flood and considerable property damage. The hardest hit communities are Madison [Old Bridge]⁵ and Matawan Townships, the Boroughs of Union Beach and Keansburg, Middletown Township and the Borough of Highlands.

(Ex. K-1 at 28 ¶ 23.)

The USACE report proposed shore and hurricane protection for Madison (Old Bridge) Township in the form of beachfill and levees. (*Id.* at 46.) The beachfill was to be used to create protective structures with heights varying between 15 feet and 5.5 feet above mean sea level. (*Id.*) It was also intended to create a beach for recreational purposes. These shore and hurricane protection measures were constructed during 1965 and 1966 as part of the Raritan Bay and

⁴ The NJDCED later was merged into the New Jersey Department of Environmental Protection (“NJDEP”).

⁵ Madison Township changed its name to Old Bridge Township in 1975.

Sandy Hook Bay Cooperative Hurricane and Shore Protection Project under the auspices of the USACE and the NJDCED, with a significant portion of the funding being provided by the federal government. Gates Construction performed the construction work. The beachfill protective structure extended from Morgan Beach to Seidler Beach, and a levee was built at the easterly end of the Site between Harding Road and Margaret's Creek. As part of the federal-state-local cooperative arrangement for implementation of these shore and hurricane protection measures, on-going maintenance was to be carried out by local interests.

John Fitch, Commissioner of the NJDCED, was designated the Superintendent of Project. As such, he and his organization were responsible for the maintenance, operation, and inspection of the beachfill and levee structures that had been constructed. James K. Rankin, Chief Engineer of the Navigation Bureau of the NJDCED, was designated as Mr. Fitch's alternate. In a letter dated March 21, 1967, Mr. Rankin indicated that the maintenance responsibility was assigned to the Madison (Old Bridge) Township Engineering and Public Works Departments. Semi-annual inspections and reports were to be submitted to the USACE documenting any changes or repairs.

Sea-Land Development Corp.'s Construction of the Seawall

By September 1968, Sea-Land Development Corp. ("Sea-Land") had ownership of the portion of the Site where the Seawall ultimately would be built. NL had no ownership in Sea-Land, or any operational or business relationship with Sea-Land. Sea-Land was interested in developing the area and was attempting to assemble 17 acres to satisfy local zoning requirements. As part of the anticipated development, Sea-Land proposed to construct the Seawall. An October 23, 1968 memorandum of James K. Rankin Chief Engineer of the NJDCED's Navigation Bureau summarized the events of a meeting held on September 6, 1968 between representatives of the State of New Jersey, of Madison (Old Bridge) Township (represented by the Township Engineer) and Sea-Land. (See attached as Exhibit "K-2" the

October 26, 1968 memorandum of James K. Rankin, Chief Engineer of the NJDCED's Navigation Bureau at 1.) The memorandum contained a notation that it related to the "Raritan Bay – Sandy Hook Bay Cooperative Hurricane and Shore Protection Project." (*Id.*) The memorandum also referred to "Madison Township – Permit 68-30," indicating that Sea-Land's proposed construction of the Seawall was part of a formal permitting process involving approval by Madison (Old Bridge) Township and/or State officials.

The NJDCED's October 23, 1968 memorandum summarized:

Sea Land proposes to build a seawall composed of slag and clay core with stone revetment on outshore side and berm. The heavy black line shows the seawall location from Wilson Avenue east to Margaret's Creek. The seawall berm is to be 15' above mean sea level and Sea Land is to fill behind it to the same elevation. The seawall would substitute for the protective feature of the beachfill placed at this location by the Army Engineers.

(Ex. K-2 at 1-2; emphasis added.)

The memorandum also noted:

Sea Land has been advised that the State would also require beachfill placement in front of the seawall so as to establish a beach in fact. Sea Land has agreed to this subject to final accord upon establishment of the cost to the Corporation.

(*Id.* at 2.) The State's beach mandate was imposed to "satisfy the public recreation benefits requirement of the federal beachfill project." (*Id.*) The memo further stated: "Sea Land has been advised that all discussions are at staff level for the purpose of reporting to higher authority for decision." (*Id.*)

On December 17, 1969, the State's Natural Resources Council approved Sea-Land's proposed acquisition of a riparian grant from the State to enable Sea Land to assemble the necessary acreage for its project, subject to certain conditions. (See attached as Exhibit "K-3" a copy of a May 20, 1970 memorandum from James K. Rankin to Director K. H. Creveling at 1.)

On May 19, 1970, representatives of the USACE and NJDCED met at the USACE's New York District Office to discuss two of those conditions. (*Id.*) The first, referred to as Condition No. 3, was: "Applicant to create a beach acceptable to the U.S. Army Corps of Engineers to replace one constructed under its coast protection project." (*Id.* at 1-2.) The second, referred to as Condition No. 4, was: "Applicant to provide public access over its property to proposed beach area." (*Id.* at 2-3.)

A memorandum drafted by Mr. Rankin of the NJDCED memorialized the results of the meeting. (*Id.* at 1-3.) As to Condition No. 3, the USACE and NJDCED agreed:

The new beach to be constructed outshore of the Sea-Land Seawall shall be equal in design to the Cooperative Project beachfill with 25' wide berm at Elevation 10 mean sea level, and frontal slope of 20 horizontal to 1 vertical. The inshore line of the 25' wide berm shall be the "Toe of Slope of Proposed Seawall" line as shown map of proposed Sea-Land grant as prepared under Case 68-131. The beachfill plan shall include appropriate fitting of the new beachfill into the existing beaches to the east and west of the Sea-Land Seawall.

(*Id.* at 1.)

The USACE and NJDCED also agreed that:

The Navigation Bureau [of the NJDCED] shall prepare contract drawings and specifications for the new beachfill and submit them to the Corps for approval in the same manner as local projects under cooperative projects are cleared. The Bureau project will be considered as an amendment to the Authorized [Raritan Bay and Sandy Hook Bay Cooperative Hurricane and Shore Protection] Project and will have to be formalized by appropriate amendment to the Local Cooperation Assurances of the Authorized Project.

(*Id.* at 2.) They further agreed that:

The new beach is to be maintained by the State and Madison (Old Bridge) Township as per Local Cooperation Assurances. The Sea-Land Seawall and the lands rearward of the seawall are the responsibility of the Owner.

(*Id.*)

The State was to obtain and furnish to the USACE a “perpetual easement” covering “the property owned by Sea-Land after the grant conveyance lying between the Toe of Seawall Line and the exterior (outshore) line of the riparian grant.” (*Id.*) The State was also to obtain from Sea-Land “an easement in perpetuity for public access across the lands of Sea-Land to the new beach at three locations along the Sea-Land bayfront . . . to assure convenient public access to the beach.” (*Id.* at 2-3) A joint field inspection by the USACE and NJDCED was planned. (*Id.* at 3.)

This memorandum demonstrates that the state and federal governments (1) had detailed knowledge regarding the planned Seawall; (2) were highly involved and exercised a great deal of control over the planning and permitting for the Seawall project; and (3) knew (and in fact required) that a public beach would be constructed abutting the Seawall, which they understood would be constructed of slag.⁶

The Western Jetty, which is also addressed in the Proposed Plan, was constructed by the USACE pursuant to authorization by Congress obtained in June 1880. Construction of the stone Western Jetty was completed in 1883. Slag is believed to have been placed on the Western Jetty during the same time period as construction of the Seawall.

Had the USACE, the NJDCED or Madison (Old Bridge) Township objected to Sea-Land’s proposal to construct the Seawall using slag, it never would have happened. Either some other material would have been used, or the Seawall and associated development would not have been built. Instead, by granting the necessary permits, approvals and permissions, the USACE,

⁶ Additional memoranda dated in October, November and December 1970 show the planning and permitting process for the project continuing under the control of the USACE and NJDCED, with acknowledgment of the need for formal approvals from Madison (Old Bridge) Township as well. (See attached as Exhibit “K-4” memoranda and meeting notes regarding the planning and permitting of the Seawall.)

the State and Madison (Old Bridge) Township all affirmatively acted to bring slag to the Site for construction of the Seawall.

Failure of State and Local Government Entities to Halt Seawall Construction Despite Contemporaneous Objections to the Use of Slag in the Seawall

Madison (Old Bridge) Township and the State also specifically knew of the lead content of the slag, and the associated environmental concerns, during the period when the Seawall was being constructed. The Chairman of the Madison (Old Bridge) Township Conservation Commission, George R. Koehler, wrote to the NJDEP in September 1972 complaining of the deposit of slag along the waterfront in Laurence Harbor and the associated environmental risks. (See attached as Exhibit “K-5” a September 29, 1972 letter from Chairman of the Madison (Old Bridge) Township Conservation Commission, George R. Koehler, to the NJDEP Solid Waste Management Division Chief, A. W. Price.) An October 3, 1972 newspaper article reported the concerns expressed by Mr. Koehler and the intention of the NJDEP to send a field representative to investigate. (See attached as Exhibit “K-6” a copy of an October 3, 1972 news article published in the News Tribune, entitled “State to probe dumping of lead slag”.) Charles Gingrich, Principal Environmental Specialist with the NJDEP’s Bureau of Solid Waste Management, did visit the Site on October 9, 1972. (See attached as Exhibit “K-7” a copy of the October 9, 1972 memorandum to file from Charles Gingrich, Principal Environmental Specialist with the NJDEP’s Bureau of Solid Waste Management at 1.) Noting that the slag was being deposited in connection with construction of the Seawall, and that the slag contained lead and other heavy metals, Mr. Gingrich referred the matter to the NJDEP’s Director of Water Resources and Director of Marine Services. (*Id.* at 4.)

Ultimately, neither the NJDEP nor Madison (Old Bridge) Township took any steps to halt the construction of the Seawall using slag, despite their knowledge that the slag contained lead

and other heavy metals and that the Seawall would abut a public beach and would have a public access easement allowing direct access by the public. This was a second chance for the State and Madison (Old Bridge) Township to prevent slag from being deposited at the Site. But, again, they failed to do so.

Nor did either the State or Old Bridge Township undertake any effort towards removal of the slag for the next 35 years. In fact, Old Bridge – which became the owner of the property in 1983 – allowed the upland area of the Margaret's Creek section of the Site to be used as a dumping ground for street sweepings and other road debris and, as a result, was cited and assessed a civil penalty for violations of the environmental laws. (See attached as Exhibit "K-8" a copy of an NJDEP Inspection Summary Report for Old Bridge Township at North of Margaret's Creek, dated February 18, 2004). Street sweepings and road debris typically contain lead, petroleum hydrocarbons and other hazardous substances.

It was not until 2007 that the NJDEP began to take action to investigate and address environmental issues associated with the Site. During the intervening time, many of the companies that were directly responsible for placement of the slag at the Site, such as Sea-Land and Liberty Trucking (believed to have transported the slag to the Site), dissolved and many of the persons involved passed away. Moreover, over that time, mechanical erosion from wave action distributed pieces of slag into nearby sediments. Now, in addition to the estimated 11,100 cubic yards of source materials EPA indicates must be addressed, there are tens of thousands of cubic yards of impacted soil and sediment that EPA has proposed should be removed.

In sum, but for the actions of the USACE, the State, and Madison (Old Bridge) Township, the slag never would have been brought to the Site. NL did not deposit slag at the Site. NL consigned its slag to a waste hauler for disposal. If any of the slag at the Site came

from NL's Perth Amboy operation (as opposed to one of the other nearby smelters), it got there as a result of the actions of third parties. It was Sea-Land that obtained the slag for use at the Site, with the knowledge and permission of the USACE, the State, and Madison (Old Bridge) Township. Thus, even if some of the slag at the Site did originate as a by-product of NL's recycling operation, most if not all of the responsibility for addressing environmental issues at the Site rests with those government entities who had direct control over the planned construction activities, approved the plans, and managed and inspected the Seawall for the last forty years. Moreover, the subsequent inaction of the NJDEP and Old Bridge exacerbated the situation and allowed others who participated with the federal, state and local governments in the planning, permitting and construction of the Seawall to walk away without consequence. Furthermore, after becoming the owner of the Site, Old Bridge allowed additional dumping of debris containing lead and other hazardous substances. Madison Township/Old Bridge was required to maintain the Seawall, knew that slag was being used to construct the Seawall but failed to use its power to prevent slag from being placed on the Seawall, took ownership of the property containing the Seawall, and then failed to take any action to address the slag for the following three decades.

It was arbitrary and inappropriate for the EPA not to include this information in the description of the Site History of the PRAP and to specifically identify the USACE, the State and Old Bridge Township as PRPs with respect to the Site. EPA's decision documents should be complete on the facts and history of this Site and make clear that Old Bridge Township is a PRP by virtue of its ownership and operation of the Site as well as its status as an arranger at the time the Seawall was constructed. Indeed, it is important to understand that the local, State and

federal governments all are likely to be key PRPs at the Site, with responsibility to pay for a substantial portion of the cost of the remedy ultimately selected.

LIST OF EXHIBITS

Exhibit A: Advanced GeoServices On-Site Containment Cell Technical Report

A-1: Bowles, Foundation Analysis and Design, 1988

Exhibit B: Advanced GeoServices Post Sandy Upland Area Condition Technical Report

B-1: November 16, 2012 letter from Christopher Reitman of Advanced GeoServices to Chris Gibson

B-2: Jetty Photos – Post Sandy

Exhibit C: Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report

C-1: Calculation of Truck Trip Miles and Probable Accidents

C-2: Estimated Carbon Dioxide Emission Equivalents

C-3: Traffic Accidents Facts and Statistics

C-4: Cost of Biofuels

Exhibit D: Advanced GeoServices TCLP Technical Report

D-1: TCLP Cost Analysis

Exhibit E: Advanced GeoServices Lead Mobility Technical Report

Exhibit F: Advanced GeoServices Principal Threat Waste Technical Report

Exhibit G: Advanced GeoServices Separation Technologies Technical Report

G-1: Carl Seward Letter with Attachment

Exhibit H: Advanced GeoServices Slag Disposal Cost Technical Report

H-1: Slag Cost Comparison

Exhibit I: Advanced GeoServices On-Site Treatment Technical Report

I-1: Material Transportation and Disposal

Exhibit J: May 22, 2012 NL RBS Site Engineering Evaluation/Cost Analysis

- Exhibit** **K-1:** 1961 United States Army Corps of Engineers Report
- K-2:** October 23, 1968 memorandum of James K. Rankin Chief Engineer of the NJDCED's Navigation Bureau
- K-3:** May 20, 1970 memorandum of James K. Rankin to Director K. H. Creveling
- K-4:** October 19, 1970 memorandum from James K. Rankin to Commissioner Joseph T. Barber; November 17, 1970 meeting notes regarding 68-131: Sea Land Meeting November 1970 in Deputh [sic] Commissioner J. T. Barber's Office; November 24, 1970 memorandum from James K. Rankin to Joseph T. Barber; December 4, 1970 meeting notes regarding 68:131 Sea Land Development Corp: Riparian Grant, Raritan Bay, Madison Township
- K-5:** September 29, 1972 letter from Chairman of the Madison (Old Bridge) Township Conservation Commission, George R. Koehler, to the NJDEP Solid Waste Management Division Chief, A. W. Price
- K-6:** October 3, 1972 news article published in the News Tribune, entitled "State to probe dumping of lead slag"
- K-7:** October 9, 1972 memorandum to file from Charles Gingrich, Principal Environmental Specialist with the NJDEP's Bureau of Solid Waste Management
- K-8:** NJDEP Inspection Summary Report for Old Bridge Township at North of Margaret's Creek, dated February 18, 2004

Exhibit L: NL March 12, 2012 Comments to the National Remedy Review Board

Exhibit M: July 13, 2012 email from Tanya Mitchell to Chris Reitman (groundwater sampling)

Exhibit N: July 5, 2012 National Remedy Review Board Comments to EPA Region 2

Exhibit O: *A Guide to Principal Threat and Low Level Threat Wastes* (OSWER document #9380.3-06FS dated November 1991);
Rules of Thumb for Superfund Remedy Selection (OSWER document #9355.0-69 dated August 1997)

Exhibit P: *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER Directive #9355.3-01 dated October 1988)

Exhibit Q: Curriculum Vitae of Christopher Reitman and Barbara Forslund of Advanced GeoServices.

Exhibit R: Excerpt From EPA's October 22, 2012 "Public Meeting Presentation"

Exhibit A to NL's Comments

**ON-SITE CONTAINMENT CELL
TECHNICAL REPORT**

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This On-Site Containment Cell Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, MI and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

NL Industries, Inc. ("NL") asked Advanced GeoServices to provide an opinion on whether a containment cell could be properly constructed in the upland area on the Margaret's Creek property (designated as Area 9 in EPA's Revised Final Feasibility Study Report ("Revised FS")) for the Raritan Bay Slag Superfund Site ("Site"). Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site. Based on our knowledge of the Site, and our personal experience on the above referenced sites, we agree with EPA that a consolidation and containment remedy like the one proposed for the upland area in Alternative 5 of the Revised FS could be successfully implemented at the Site. We disagree with EPA's contention in the Proposed Remedial Action Plan ("Proposed Plan") that leaching and settlement issues are relevant issues and could possibly preclude the use of an on-Site containment cell in the upland portion of the Margaret's Creek property. The basis for our conclusions that a containment remedy would perform effectively in the upland area of the Site is discussed below.

Opinion: An On-Site Containment Cell Can Be Properly Designed to Effectively Contain Lead at the Site

EPA's conclusion in the Revised FS that an on-site containment remedy for lead source material is protective of human health and the environment is well supported on technical grounds and there are numerous case studies demonstrating that this approach presents a sound, protective remedial solution for these types of materials. Lead, the contaminant of concern, is not highly mobile. Even in the unprotected environment within the bay at this Site, the lead is bound up in the massive and heavy kettle bottoms (also called "pots" or "slag"). These kettle bottoms have



been present for over 40 years at the seawall and jetty areas of the Site, but despite being in an uncontrolled environment and subject to wave action for this long period of time, EPA's Remedial Investigation shows that lead has not migrated far from the original kettle bottom source materials. This is partly because the lead in those kettle bottoms is essentially insoluble in the bay environment, and the principal transport mechanism at the Site is mechanical weathering. *See* November 27, 2012 Advanced GeoServices Lead Mobility Technical Report at Exhibit E for more discussion of the mobility of the lead contained at the Site.

It is the opinion of Advanced GeoServices that an on-site containment remedy can be properly designed to effectively address the lead contaminant of concern by isolating the soils, sediments and source materials in the upland area of the Site. There are well-proved design elements that have been used at multiple sites across the United States to effectively prevent exposure to metal bearing materials like lead. The purpose of the design elements is to prevent direct exposures to the materials by capping the top of the cell. In addition, multiple technologies are available to prevent the infiltration of water into and out of the sides and bottom of the containment cells (surface water, rain water and groundwater). For this Site, a multi-layer cap would be placed over the entire containment area. This would prevent any direct exposure to the lead materials. The cap would have soil and geomembrane components, each of which would prevent water from coming into contact with the lead in the soil. The cap would prevent infiltration of water, so the lead-bearing materials would be isolated from infiltrating water. While Advanced GeoServices does not believe a leachate collection system is necessary to contain the lead bearing materials at the Site, because the materials are inert and do not degrade with time or produce liquids, such a system could be installed below the lead bearing materials to collect any infiltrating water. The leachate collection system would also collect any water draining from the material at the time of placement. In addition, a geosynthetic liner could be placed below the lead bearing material to isolate it and prevent any contact with underlying soils or groundwater. These types of isolation technologies are proven and routinely used on landfill applications and similar Superfund and RCRA remedies for lead and other metals.

Test borings from the installation of monitoring wells at the Site show that the soils underlying the upland containment area are comprised of low plasticity clay. Such clay is highly suitable to underlie a containment area for metal bearing wastes as they have low permeability and a high binding capacity such that if a minor amount of leaching occurred from the wastes, the dissolved metal would bind to the clay and not migrate further. The boring also describes the presence of mica flakes within the subsoils that also indicate that the likely clay mineral is illite which has a moderate cation exchange capacity. To the extent that the subsoils also contain organic carbon, this will also improve the binding capability of the soils surrounding the containment area. These native materials are as suitable as geosynthetics to prevent the migration of contaminants from a closed containment area for metal bearing materials.

Use of On-Site Containment Remedies for Metals Contamination is Routine

Advanced GeoServices designed and oversaw installation of successful and effective permanent on-site capping/containment/isolation remedies for metals at many sites, including the Revere Superfund Site, the Jack's Creek Superfund Site, and the Marjol Battery RCRA Site, which were



all bordered by residential communities. None of these sites have bottom liners and, similar to the Site, none show signs of leaching to groundwater before or after capping. Each of these sites was a significant project and had over 75,000 cubic yards of materials which was safely contained. The groundwater monitoring programs at each of these sites show no signs of leaching or movement of the lead/metals out of the containment system. The Revere Superfund Site is actually a park available for public use.

Advanced GeoServices also designed on-site remedies at the Gould Superfund Site in Portland, Oregon and the Revere Smelter located in Middletown, New York, which included bottom liners and leachate collection systems. These remedies have also performed successfully. The Gould Superfund Site in Portland, Oregon has a leachate collection system, which ceased to collect liquids following closure since the required cap and liner system is successfully preventing infiltration. Mr. Reitman and Ms. Forslund were personally involved in each of the above-referenced projects.

Although on-site containment remedies may require future operation and maintenance, the inclusion of operation and maintenance requirements is routine for remedies at Superfund sites, especially those involving lead and metals contamination. Operation and maintenance is not of particular concern for the Seawall and Margaret's Creek portion of the Site because the lead could be isolated in an upland portion of the property. Since the property is owned by a municipal entity, Old Bridge Township, cap management activities can be integrated into routine maintenance activities completed by the Township at the park.

Comply with ARARs

The on-site containment remedies (Alternatives 3 – 5) considered in the Revised FS all comply with applicable or relevant and appropriate requirements (“ARARs”) as that term is used in CFR § 300.430(f)(1)(ii)(B). As EPA noted in the Revised FS:

Alternatives 3 – 5 would comply with chemical-specific ARARs through various remedial activities.... Alternatives 2 through 5 would comply with action-specific ARARs by implementing health and safety measures during the remedial action, and by meeting regulatory requirements necessary for remedy implementation.
(Revised Final Feasibility Study, Pg. ES-12)

These same findings were echoed in EPA's Public Meeting Presentation, which stated that Alternatives 3 – 5 all “meet criteria” for compliance with ARARs. (EPA RBS Superfund Site Power Point, October 22, 2012, Pg. 43)

EPA's conclusion that remedies including on-site containment would comply with all ARARs is not surprising since on-site containment of lead-impacted materials is a common approach used at many sites throughout the nation as described above.



Short-Term Effectiveness and Implementability

An on-site remedy has substantial advantages with regard to short-term effectiveness and permanence compared to the remedy recommended in the Proposed Plan. An on-site remedy can be implemented quicker, with less truck traffic, less risks, with less material being imported from off-site, with less emissions and at a substantially lower cost. These advantages are described further in the November 27, 2012 Advanced GeoServices' Remedy Implementation Negative Short Term Impacts Technical Report at Exhibit C.

Long-Term Effectiveness and Permanence

EPA correctly found that remedies including on-site containment satisfy the NCP criteria for long-term effectiveness and permanence set forth at 40 C.F.R. § 300.430(e)(9)(iii)(C). As EPA stated in the Revised FS:

Alternatives 2 through 5 would remove the contaminated materials from the current unprotected locations and **would achieve long-term effectiveness and permanence**. Alternatives 3 through 5 would achieve long-term effectiveness through a combination of removal, off-site disposal, on-site containment and capping and would be permanent if long-term site controls are maintained. (Emphasis added.)

Ground Settlement is Not an Issue at the Site

EPA retained a consultant, Engineering Technologies, to provide an opinion of the potential for ground settlement in the area of the proposed containment cell (in the upland area of the Margaret's Creek property); the letter is provided as part of an Attachment to Appendix D of the Revised FS. In this letter, the engineer states that foundation settlement on the order of 4 to 8 inches for a 15-foot high containment cell is indicated based upon review of boring logs, and that it is very likely that the settlement may not be uniform. The EPA consultant concluded their analysis by saying:

Based on the evaluation of the preliminary subsurface information it can be concluded that the Site may be suitable for use as a disposal Site. At this time, although the preliminary subsurface investigation suggests that the Site conditions may be suitable for the intended use, it is considered advisable that contingency funds be allocated for subsurface improvement **if** further explorations suggest the need for such improvements. (Emphasis added.)

Advanced GeoServices also reviewed the boring log in the upland portion of the Margaret's Creek property and we agree the area is well suited for a disposal facility and we also agree that the current data does not suggest a ground settlement issue.



Standard penetration test results (blow counts) which are a primary indicator of the compactness of the in-place soils are in the range of 5 to 8 in the zone immediately below the bottom of the proposed containment area of the Site, if one was constructed there. Such soils would be suitable for the construction of a one to two story building without the required type of modification that EPA has suggested is necessary. The clay soils present at the Site also are described as being medium stiff, non-plastic and dry; descriptors that would indicate that long-term consolidation settlement that can occur in more moist, plastic clays would not be a concern here. Furthermore, vibroflotation as recommended by EPA's expert is not suitable for clay materials (Bowles, Foundation Analysis and Design, 1988, p. 296 attached as **Exhibit A-1**) such as those that underlie the upland area of Margaret's Creek. It is only applicable to loose sand layers and may not be effective when such soils are below the water table. It is our opinion, given the results of the standard penetration tests and the description of the subsoils, that the potential settlement, if any occurred at all, would be more on the order of 2 to 3 inches considering the blow counts recorded in boring MW-15S and the description of the clay layers or lenses as being medium stiff, non-plastic and dry. This is well within the range which can be accommodated by these types of containment facilities. Some of the sand layers are described as "loose" but at a shallow enough depth that they will be compacted by the subgrade preparation using conventional equipment. For a containment cell, even one with liners and a leachate collection system, it is not necessary for settlement to be even, and settlement on the order of several inches is easily accommodated by the geosynthetics that would be used.

In summary, it is Advanced GeoServices' opinion that the costs included in Revised FS Alternatives 3 through 5 for ground improvements to prevent settlement are excessive and not required for the Site based on the available data. The discussion of these potential issues in the Proposed Plan is unsupported by the Site data. The cost allocated to address these unsupported issues and the discussion of these issues in the Proposed Plan is misleading and suggests a potential problem where no problem has been documented to exist. This excessive conservatism has inflated the cost of an on-site remedy, making the on-site alternatives appear to be more expensive than they actually would be.

Conclusion

Based on the contaminant of concern, the properties of the lead source materials at this Site and our knowledge and understanding of containment remedies, it is the opinion of Advanced GeoServices that an on-site containment remedy in the upland area of Margaret's Creek would effectively isolate the lead contaminated soils, sediments and source materials. This is a routine remedy, which can be properly designed using proven engineering to address all potential concerns.



Attachment A-1

Bowles, Foundation Analysis and Design, 1988
(Copy of front of book, inside table of contents, and pages 295-297)

FOUNDATION ANALYSIS AND DESIGN

Fourth Edition

Joseph E. Bowles, P.E., S.E.

*Consulting Engineer/Software Consultant
Engineering Computer Software
Peoria, Illinois*

McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá Caracas
Colorado Springs Hamburg Lisbon London Madrid Mexico Milan
Montreal New Delhi Oklahoma City Panama Paris San Juan
São Paulo Singapore Sydney Tokyo Toronto

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TABLE 6-1 Approximate relationship between earthquake magnitude, relative density and liquefaction potential for water table 1.5 m below ground surface†

Earthquake acceleration	High liquefaction probability	Potential for liquefaction depends on soil type and earthquake acceleration	Low liquefaction probability
0.10g	$D_r < 33\%$	$33 < D_r \leq 54$	$D_r > 54\%$
0.15g	< 48	$48 < D_r \leq 73$	> 73
0.20g	< 60	$60 < D_r \leq 85$	> 85
0.25g	< 70	$70 < D_r \leq 92$	> 92

† From Seed and Idriss (1971).

The particular attraction of wick drains is economy since per meter installation costs are typically one-quarter to one-fifth that of sand drains. They can be installed to depths up to 30 m using a conventional vibratory hammer (as used for pile driving) and a special wick installation rig. According to Morrison (1982) wick drains have about 80 percent of the soil consolidation market. Several references on wick drains are cited by Holtz (1978).

The same approximate equations for sand drains can be used for wick drains to establish spacing and estimate time for consolidation to occur.

Note that wick drains provide no strengthening effect on the soil (unless horizontal) except that provided from reducing the void ratio and water content.

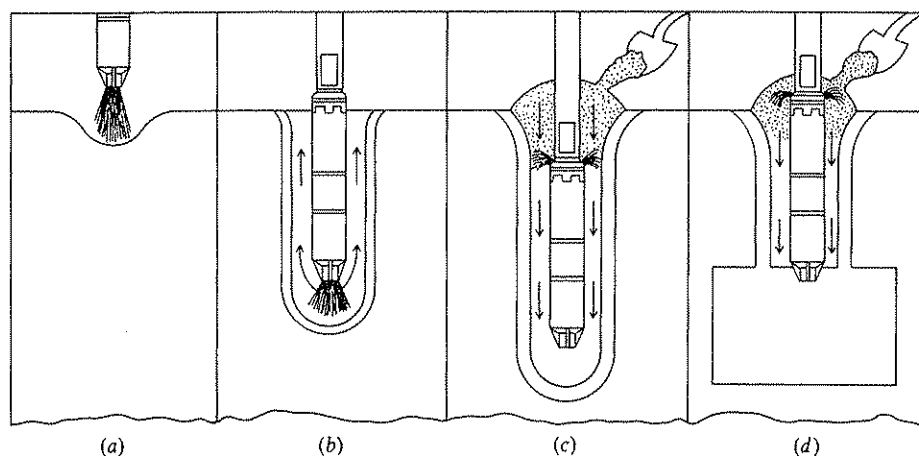
6-5 VIBRATORY METHODS TO INCREASE SOIL DENSITY

The allowable bearing capacity of sands depends heavily on the soil conditions. This is reflected in the penetration number or cone resistance value as well as in the angle of internal friction. It is usually not practical to place a footing on loose sand because the allowable bearing capacity (based on settlements) will be too low to be economical. Additionally in earthquake analyses the local building code may not allow construction unless the relative density is above a certain value. Table 6-1 gives liquefaction-potential relationships between magnitude of earthquake and relative density for a water table 1.5 m below ground surface. This table can be used for the GWT up to about 3 m below ground surface with slight error. The relative density may be related to penetration testing as in Table 3-2 after correcting to N for overburden using C_N of Eq. (3.3).

The methods most commonly used to densify cohesionless deposits of sand and gravel with not over 20 percent silt or 10 percent clay are vibroflotation and insertion and withdrawing a vibrating pile [Terra-Probing, see Janes (1973)]. Vibroflotation (patented by the Vibroflotation Foundation Co.) utilizes a cylindrical penetrator about 432 mm in diameter, 1.83 m long, weighing about 17.8 kN. An eccentric weight inside the cylinder develops a horizontal centrifugal force of about 90 kN at about 1800 rpm. The device has water jets top and bottom with a flow rate of between 225 and 300 L/min at a pressure of 430 to 580 kPa. Figure 6-3

illustrates the procedure for vibroflotation. The device sinks at a rate of between 1 and 2 m/min into the ground into the "quick" zone under the point caused by a combination of excess water and vibration. When the vibroflot reaches the desired depth, depending on footing size and stratum thickness, say $2B$ to $3B$, after a few moments of operation the top jet is turned on and the vibroflot is withdrawn at the rate of about 0.3 m/min. Sand is added to the crater formed at the top from densification as the device is withdrawn—typically about 10 percent of the compacted volume. Compaction rates of 7500 to 15 000 m³ in an 8-h work shift are common. The probe is inserted on 1- to 3- or 5-m centers depending on densification desired—maximum densification being in the immediate vicinity of the probe hole. Bearing capacities of 250 to 400 kPa can be obtained using this method.

The Terra-Probe (patented by the L. B. Foster Co.) method involves mounting a vibratory pile driver on a probe (pile) and vibrating it into and out of the soil to be densified. This device is applicable to soils in which the vibroflotation



(a) Vibroflot is positioned over spot to be compacted, and its lower jet is then opened full.

(b) Water is pumped in faster than it can drain away into the subsoil. This creates a momentary "quick" condition beneath the jet which permits the Vibroflot to settle of its own weight and vibration. On typical sites the Vibroflot can penetrate 15 to 25 ft in approximately 2 min.

(c) Water is switched from the lower to the top jets, and the pressure is reduced enough to allow water to be returned to the surface, eliminating any arching of backfill material and facilitating the continuous feed of backfill.

(d) Compaction takes place during the one-foot-per-minute lifts which return the Vibroflot to the surface. First, the vibrator is allowed to operate at the bottom of the crater. As the sand particles densify, they assume their most compact state. By raising the vibrator step by step and simultaneously backfilling with sand, the entire depth of soil is compacted into a hard core.

FIGURE 6-3 Vibroflotation.



Exhibit B to NL's Comments

**POST SANDY UPLAND AREA CONDITION
TECHNICAL REPORT**

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Post Sandy Upland Area Condition Technical Report was prepared under the direction of Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. asked Advanced GeoServices to provide an opinion with regard to whether the impacts of Hurricane Sandy on the area demonstrate that placement of a containment cell in the upland area of the Raritan Bay Slag Superfund Site (the "Site") would be inappropriate. The answer to that question is no. Based on our experience siting large containment cells, which is described above, and our Site visit following the hurricane, it remains our opinion that the upland area of the Site is well-suited for on-site containment and that the location of the containment cell proposed in Alternatives 3 – 5 of EPA's Revised Final Feasibility Study Report (Revised FS) is appropriate as evidenced by the minimal impact to that area from perhaps the most severe storm surges the area has ever experienced.

Although Hurricane Sandy heavily damaged the beach, the park, the marina and certain residential neighborhoods, the storm had little impact on the Margaret's Creek upland location where the containment cell would be constructed. The proposed containment cell location is outside the 100 year floodplain. **Attachment B-1** to this report is a November 16, 2012 letter report from a Site visit conducted by Advanced GeoServices days after Hurricane Sandy, which includes photographs that clearly show that the storm had little or no impact on the upland area of the Margaret's Creek area of the Site where the containment cell would be located. Moreover, although other material used to construct the Seawall (such as uncontaminated construction debris) was washed from its location, the large and heavy kettle bottoms (also called "pots" or



“slag”) remained intact and largely in place, demonstrating that this material is not likely to move, especially if it is contained in this area of the Site in a properly designed containment unit in the upland area of the Site using proven containment cell engineering. Thus, the recent storm has confirmed EPA’s conclusion that remedies including on-site containment could be designed to be fully protective of human health and the environment.

Likewise, the slag located on the Jetty was not significantly impacted by the Sandy storm and remained largely intact and in place. Provided in **Attachment B-2** are some photos of the Jetty taken by Advanced GeoServices during its Site visit on November 3, 2012 after the storm.



Attachment B-1

**November 16, 2012 letter from Christopher Reitman of Advanced
GeoServices to Chris Gibson**



1055 Andrew Drive, Suite A
West Chester, PA 19380-4293
tel 610.840.9100 fax 610.840.9199
www.advancedgeoservices.com

November 16, 2012

2007-1973

Chris Gibson
Archer & Greiner
One Centennial Square
Haddonfield, NJ 08033

Re: Trip Summary Report
Margaret's Creek Upland Area

Dear Mr. Gibson:


On Saturday November 3, 2012, representatives of Advanced GeoServices (Kevin O'Rourke and Chris Reitman) visited and observed the condition of the Margaret's Creek Upland Area which is part of the Raritan Bay Superfund Site. The storm surge and rain associated with hurricane Sandy had passed through New Jersey on Monday, October 29th and Tuesday October 30th. The purpose of my trip was to understand the impacts of the rain and storm surge and the associated recent flooding on the Upland Area, near Route 35, where a containment cell for the consolidated material is proposed.

Prior to my visit to the Upland Area I had observed significant surge impacts from the Raritan Bay within the Old Bridge Waterfront Park and in other shoreline areas. I also observed signs of flooding within the Margaret's Creek property close to Seidlers beach. However, within the upland area, near the proposed cap area shown on the attached drawing, I saw essentially no impacts from the flooding. The leaves adjacent to the road had not migrated onto the road and the stone cover on the road showed no signs that sand had migrated onto this area, as it had closer to the Raritan Bay. I saw no signs of flooding or recent damage from water in the upland area shown on the attached drawing. The upland area observed is outside the 100 year floodplain, so the minimal flood impacts in this area are not surprising. Attached are several photos of the area taken on my visit on November 3 which support the observations described above.

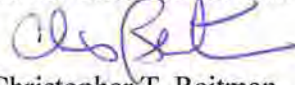
If you have any questions regarding this information please do not hesitate to contact me us at 610-840-9100.

Very truly yours,

ADVANCED GEOSERVICES CORP.



Kevin O'Rourke
Senior Staff Professional



Christopher T. Reitman
Senior Project Consultant

Attachments

KO:CTR:kk

UPLAND AREA SITE VISIT

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Figure 2-2
Investigation Areas
Raritan Bay Slag Site



NL-RBS 000073



NL-RBS 000074



NL-RBS 000075



Attachment B-2

Jetty Photos-Post Sandy



Western jetty conditions on November 4, 2012 following the storm.



Western jetty conditions on November 4, 2012 following the storm.

Exhibit C to NL's Comments

**REMEDY IMPLEMENTATION NEGATIVE SHORT TERM
IMPACTS TECHNICAL REPORT**

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Remedy Implementation Negative Short Term Impacts Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. requested Advanced GeoServices to provide an opinion on the negative short-term effects and implementability considerations of an off-site removal remedy like Alternative 2 in EPA's Revised Final Feasibility Study Report ("Revised FS"), compared to an on-site remedy, like Alternative 5. Alternative 5 includes construction of a containment cell in the upland area (Area 9) of the Raritan Bay Slag Superfund Site (the "Site"). Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site and the EPA FS guidance (EPA, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, October 1988) to help evaluate this issue. It is our opinion that the Revised FS incorrectly implies that the short-term impacts of the off-site remedies and the on-site remedies are equivalent. We do not believe this is accurate. The negative short term impacts and implementability issues associated with an off-site disposal remedy present substantial issues that will severely impact the community and the project in the following ways: (1) the number of trucks coming to and going from the Site will create the potential for accidents and serious injuries; (2) considerable additional emissions will be created due to additional truck miles traveled; (3) the project duration will be extended due to limited available daily landfill capacity and hazardous waste trucks; and (4) the local traffic congestion will increase. As described below, we believe an on-site containment remedy that includes placing a containment cell in the Margaret's Creek upland area of the Site provides significant advantages with regard to each of these criteria, and these advantages should be considered in any analysis conducted by EPA.



Off-site Disposal Has Far More Negative Impacts than On-site Containment Remedies

The Revised FS states that although off-site remedies would involve more truck traffic, remedies involving on-site containment would involve more construction work at the Site. The location of the proposed on-site containment units are relatively isolated and in close proximity to the materials to be consolidated. The Margaret's Creek upland area is only accessed by Old Bridge utility workers and the property adjacent to the Western Jetty is vacant, currently subject to a tax lien, and is not presently used by anyone. Construction in such areas would have an insignificant impact on the community. The total off-site remedy (Alternative 2), on the other hand, would inundate the community with large trucks coming to and going from the Site that would adversely impact local infrastructure, cause traffic congestion, increase carbon emissions by the use of thousands of gallons of fossil fuel, and drastically increase the risk of accidents and injuries on local roads.

Trucking Impacts to the Community

The magnitude of off-site trucking associated with EPA's preferred alternative (total off-site disposal - Alternative 2) presented in the Proposed Remedial Action Plan ("Proposed Plan") would have substantial detrimental impacts to the community and is understated in EPA's decision documents. Each truckload of the material sent off-site would have to be transported over 680 miles roundtrip to a disposal facility located in Yukon, Pennsylvania and additional backfill materials would need to be imported. Based on the estimated 176,000 tons (92,000 CY) of materials that must be taken off-Site for disposal and approximately 138,000 tons of clean materials brought on-site for restoration, approximately 7,852 full truck loads with an equal number of empty truck loads would be required to implement this alternative. Each trip would require transport of materials up to 680 miles for a round trip, requiring a three day roundtrip to get to its intended destination and back. This results in over 5.9 million miles traveled plus an additional 880,000 miles for clean replacement soils for a total of almost 6.8 million miles for this alternative as shown on **Attachment C-1** to this Report.

These thousands of trucks will have to line up and be staged on local roads near the Site to receive materials for off-site disposal or wait to unload clean materials. The main thoroughfare that would be utilized (Route 35) is not amenable for the number of trucks that would be required and is in close proximity to the Site. **Attachment C-2** to this Report provides the estimated off-site emissions associated with this alternative are 25,040,250 lbs. carbon dioxide equivalents (CO₂e).

As the facts and statistics included in **Attachment C-3** to this Report show, traffic congestion and the vehicle accidents that inevitably result are already significant issues in Middlesex County in general and on Route 35 in particular. New Jersey State Police records show that Middlesex County already has the highest number of vehicle accidents and the highest number of resulting fatalities of any county in New Jersey. (<http://www.njsp.org/info/fatalacc/pdf/ptccr.pdf>). New Jersey Department of Transportation (NJDOT) records (attached) show that Route 35 in particular is among the top 19% of roads in New Jersey with the highest accident rates in 2012 (<http://www.state.nj.us/transportation/refdata/accident/pdf/crashrate.pdf>). Further, Route 35 is a four-lane road with no shoulder which makes it one of the most statistically prone types of roads to



accidents as shown on the attached “Fatal Accident Investigation Unit Year to Date–Victim Classification by County for November 20, 2012” (http://www.state.nj.us/transportation/refdata/accident/pdf/crash_geometry.pdf). The substantial additional truck traffic on Route 35 in Old Bridge that would occur if the Alternative 2 total off-site disposal remedy was implemented would exacerbate what already is a difficult situation by creating a significantly increased risk of vehicle accidents. This is supported by statistics which show trucks are the most common type of vehicle in accidents and trucks are 8 times more prone to accidents involving cars compared to single trucks or other vehicles, *Analysis of Truck Accident Reports in Work Zones in New Jersey* (August 1997). See **Attachment C-3**.

Substantial risks from truck accidents are consistent with studies of other remediation sites. A study entitled “Estimated Risk of Occupational Fatalities Associated with Hazardous Waste Site Remediation” (Hoskin, et al., 1994) analyzes the risks of fatal accidents associated with remediation. The study shows trucks were statistically more likely to be involved in serious accidents than any other construction equipment. The thousands of additional trucks on the roads near the Site would substantially increase the chances for vehicle accidents and potentially serious injuries within the local community.

The substantial off-site truck traffic required to implement EPA’s preferred off-site disposal remedy would also cause traffic congestion, delays, and additional road maintenance needs resulting from wear and tear on roads from heavy trucks, all of which would impact the local businesses and residents of the community. The thousands of extra truck trips would also increase noise, dust and exhaust emission pollution.

In comparison, performance of an on-site containment remedy would have far fewer of these kinds of negative impacts. The on-site containment remedy will be performed inside a secure and controlled area. Except for mobilization and demobilization of equipment and clean materials brought in for restoration of the Site, there would be no need for truck traffic on roads outside the site. Noise, dust and other negative impacts of an on-site remedy could be controlled by construction methods, planning, security, and site control measures, and so, would not impact the community as drastically as the total off-site remedy chosen in the Proposed Plan. Advanced GeoServices also believes that an on-site containment remedy could be more quickly implemented than the off-site remedy as explained in the paragraph that follows.

Limited and Daily Capacity at Off-site Disposal Facility and Availability of Hazardous Waste Trucks

Based on recent Advanced GeoServices discussions with the regulated disposal facility in Yukon, PA, there is a limited daily capacity of 500-1,000 tons of material that can be received at the facility. Additionally, it has been the experience of Advanced GeoServices on many similar large projects including the Marjol Battery Site, which was completed within the last 2 years, that there is limited availability of hazardous waste trucks to provide transportation. These limitations would increase the time for construction of the off-site remedy to at least two construction seasons. An on-site containment remedy could much more easily be performed in one construction season.



EPA Sustainability Analysis of Remedy

As noted above, one of the great differences in the off-site vs. on-site disposal remedies is the thousands of heavy truck loads that will be transported over hundreds of additional miles each way. Although EPA admits in Section 4.5.8 of the Revised FS that off-site disposal has the highest greenhouse gas emissions (and thus is less sustainable) than other alternatives, it implies that this concern has been addressed by a promise, unsupported anywhere in the decision documents, to consider the use of fuel efficient vehicles (for transporting contaminated materials) and biofuels. If such changes are actually going to be made, then they should be considered in the cost estimates for the Site. Doing so will show that Alternative 2 actually is even less cost-effective than is presented in the Revised FS and Proposed Plan.

In the Revised FS, EPA acknowledges that its selected alternative, Alternative 2 (total off-site disposal), has the highest estimated greenhouse gas emissions due to high fuel consumption; however, EPA does not provide any calculations to show the magnitude of the difference between Alternative 2 and the on-site containment alternatives. Advanced GeoServices' analysis in **Attachment C-2** to this Report shows that EPA's selected alternative will generate an almost 10-fold increase in the pounds of carbon dioxide equivalents (approximately 25 million pounds of CO₂ equivalents compared to 3.3 million CO₂ equivalents for the transportation component of the remedies, (i.e. the transport of contaminated materials from the Site and the import of clean materials to the Site) than a total on-site containment alternative. The mitigating measures that EPA mentions in the Revised FS, such as using biodiesel in lieu of conventional diesel and electricity from 100% renewable sources are not realistic or reasonable. There are no biofuel refueling stations on the route between Old Bridge/Sayreville and Yukon, PA where the Subtitle C treatment facility is located, even for minimal grade blends such as Biodiesel Fuel B20 (US Dept of Energy Alternative Fueling Station Locator www.afdc.energy.gov/locator/stations). Use of higher grades of biodiesel would require retrofitting of the diesel engines. (National Petroleum Council Future Transportation Fuels Study, August 1, 2012) The closest fueling station is over 21 miles from the Site in Maplewood, N.J. (US Department of Energy Alternative Fueling Station Locator www.afdc.energy.gov/locator/stations). Turning engines off to avoid idling as suggested by EPA in the Revised FS (page 4-23) is impractical in terms of driver comfort as it would preclude use of air conditioning or heat in the driver's compartment. Nor has the cost of these suggested potential mitigating factors been included in the cost estimates presented in the Revised FS.

Biodiesel is at least 6% more expensive than conventional diesel for the lowest blend and 42% more expensive for the higher percentage blends. (US Department of Energy Clean Cities Alternative Fuels Price Report, July 2012) Biodiesel is also less fuel efficient and does not provide the same level of motive power as conventional diesel. (National Petroleum Council Future Transportation Fuels Study, August 1, 2012) Consequently more fuel is required to accomplish the same task. Use of biodiesel could add up to \$5 million to the cost of Alternative 2 for the transportation portion of the project alone. When factoring in the cost of fuel into the remaining operations such as excavation and treatment plus the added cost of obtaining all electricity from renewable sources (another approach EPA says in the Revised FS it will consider incorporating into the remedy), this increased cost could easily double to add about 10% to the overall cost of the remedy. These figures are presented in **Attachment C-4**.



Conclusion

It is Advanced GeoServices opinion that the off-site alternative proposed by EPA has significantly more negative short-term impacts than an on-site remedy. Implementing an on-site containment remedy will eliminate the need for off-site transport of the impacted material to a Subtitle C treatment facility and greatly reduce the number of accidents, emissions, traffic congestion and project duration. EPA does not appear to have adequately considered these factors in its decision documents for the Site.



Attachment C-1

Calculation of Truck Trip Miles and Probable Accidents

Raritan Bay Slag Superfund Site
Trucking Miles and Probable Trucking Accidents

Alternative 2 (EPA FS Sept. 2012) EPA Full Removal, Off-site Transport & Crushing, Treatment and Disposal						
	Est Weight Materials (Tons)	Total Loads (# Trucks)	Miles to/from Disposal Facility per load (round trip)	Miles to/from Replacement Material Source (round trip)	Total Truck Miles	Probable Accidents
Removal / Restoration Areas						
Seawall Sector						
Source (Haz)	23,100	1,155	680		785,400	0.30
Soil (Haz)	41,300	2,065	680		1,404,200	0.53
Sediment (Haz)	18,100	905	680		615,400	0.23
					0	
Jetty Sector					0	
Source (Haz)	21,500	1,075	680		731,000	0.28
Soil (Haz)	2,300	115	680		78,200	0.03
Sediment (Haz)	40,400	2,020	680		1,373,600	0.52
					0	
Margaret's Creek Sector					0	
Source (Haz)	3,100	155	680		105,400	0.04
Soil (Haz)	26,300	1,315	680		894,200	0.34
Sediment (Haz)	0	0	680		0	0.00
subtotal	176,100	8,805			5,987,400	2.28
Replacement Material Volume	138,000	6,900		100	690,000	0.26
Estimated Project Total	314,100	24,510			6,677,400	2.54

Assumptions / Notes

1. All material assumed to be Hazardous and disposed in Subtitle C Facility in Yukon, PA approximately 340 miles from the Site (based on AGC review of TCLP data)
2. Assumed 50-mile roundtrip for replacement materials.
3. Tonnage based on EPA Alternative 2 Table 2-5 which uses a conversion factor of 1.7 tons/cy for sediment, 1.5 tons/cy for soil and 4.3 tons/cy for source materials.
4. Weight per on-road truck is assumed to be 20 tons per truck load. Number of allowable tons received by facility is 1,000 tons per day.
5. Replacement volume assumed to 100% of removed material (138,000 tons at 1.5 tons/cy is 92,000 cy); no on-site soils used for backfill of areas.
6. Probable accidents based on attached calculation.

Raritan Bay Slag Superfund Site
Trucking Miles and Probable Trucking Accidents

Alternative 2 (EPA FS Sept. 2012) On-site Crushing/Treatment and Subtitle D Transport and Disposal						
	Est Weight Materials (Tons)	Total Loads (# Trucks)	Miles to/from Disposal Facility per load (round trip)	Miles to/from Replacement Material Source (round trip)	Total Truck Miles	Probable Accidents
Removal / Restoration Areas						
Seawall Sector						
Source (Haz)	23,100	1,155	100		115,500	0.04
Soil (Haz)	41,300	2,065	100		206,500	0.08
Sediment (Haz)	18,100	905	100		90,500	0.03
			100		0	
Jetty Sector			100		0	
Source (Haz)	21,500	1,075	100		107,500	0.04
Soil (Haz)	2,300	115	100		11,500	0.00
Sediment (Haz)	40,400	2,020	100		202,000	0.08
			100		0	
Margaret's Creek Sector			100		0	
Source (Haz)	3,100	155	100		15,500	0.01
Soil (Haz)	26,300	1,315	100		131,500	0.05
Sediment (Haz)	0	0	100		0	0.00
subtotal	176,100	8,805			880,500	0.33
Replacement Material Volume	138,000	6,900		100	690,000	0.26
Estimated Project Total	314,100	24,510			1,570,500	0.60

Assumptions / Notes

1. All material assumed to be non-hazardous and disposed in Subtitle D Facility in New Jersey less than 50 miles from the Site (based on the ability to treat on-site).
2. Assumed 50-mile roundtrip for replacement materials.
3. Tonnage based on EPA Alternative 2 Table 2-5 which uses a conversion factor of 1.7 tons/cy for sediment, 1.5 tons/cy for soil and 4.3 tons/cy for source materials.
4. Weight per on-road truck is assumed to be 20 tons per truck load.
5. Replacement volume assumed to 100% of removed material; no onsite soils used for backfill of areas.

Introduction

The following accident probability calculations are based on data compiled by the Pennsylvania Department of Transportation Center for Highway Safety in 1988. This information indicated that 38 vehicle accidents occurred on Pennsylvania interstate highways every 100,000,000 miles traveled. It should be noted that this information does not distinguish between minor "fender benders" and major crashes.

The accident probability for heavy truck traffic for each remedy is based on the aforementioned probability rate and the estimated average distance (EAD) from a material source to the site. The EAD for specific alternatives is presented in the applicable alternative.

EPA Alternative 2 Excavation/Dredging, Off-site Transport, Treatment and Disposal

Input data:

- The estimated amount of material to be transported off-site for treatment and disposal based on EPA estimates in the September 2012 FS is 176,100 tons. AGC determined all material would be characterized as hazardous based on TCLP review.
- Assume 20 tons per truckload. 8,805 truck trips or 5,987,400 miles traveled.
- Duration = (9 months [one construction season]) (22 days per month) = 198 days
- The material will likely be sent to a Subtitle C Facility in Yukon, Pennsylvania, therefore an EAD of 340 miles was chosen.

Import Clean Material

Input data:

- Amount of clean imported fill material required for this alternative is 176,100 tons.
- Assume 20 tons per truckload. 8,805 truck trips or 880,500 miles traveled.
- Duration = (9 months [one construction season]) (22 days per month) = 198 days
- Much of the imported material is likely to be from New Jersey, New York or Pennsylvania, therefore an EAD of 50 miles was chosen.

Transport and Disposal Accident Calculation (20 tons per truck) :

$$\frac{38 \text{ Accidents}}{100,000,000 \text{ miles}} = \frac{\text{Probable Accidents}}{(176,100 \text{ tons}) \times (340 \text{ mi.})(2)} \quad \text{Probable accidents} = \mathbf{2.27}$$

(20 tons per truck)

Replacement Material Accident Calculation (20 tons per truck) :

$$\frac{38 \text{ Accidents}}{100,000,000 \text{ miles}} = \frac{\text{Probable Accidents}}{(138,000 \text{ tons}) \times (50 \text{ mi.})(2)} \quad \text{Probable accidents} = \mathbf{0.26}$$

(20 tons per truck)

Total Number of Probable Accidents = **2.54**



Attachment C-2

Estimated Carbon Dioxide Emission Equivalents

**Raritan Bay Slag Superfund Site
Carbon Emissions Calculation**

Alternative	Type of Material	Material (tons)	Number of Loaded Trucks On-site	Number of Loaded Trucks on Local Roads	Miles per Trip	Miles traveled	Carbon Dioxide Equivalent CO ₂ e (lbs.)
On-site Containment (Margaret's Creek Containment Area only)	Material transported from WJ Sector to MC Sector	64200		3210	6	19,260	72,225
	Material transported from Seawall Sector to MC Sector	82500	2063		2	4,125	15,469
	Replacement fill (imported)	146,700		7335	100	733,500	2,750,625
	Structural fill for berms	12,000	300		Available on-site	-	
	Containment area cover soils	16,133		807	100	80,665	302,494
	Containment area liner soils	8,066		403	100	40,330	151,238
Totals			2,363	11,352		877,880	3,292,050
Off-site Disposal (EPA FS Alternative 2)	Source materials (haz facility)	47,700		2,385	680	1,621,800	6,081,750
	Sediment/soils (haz facility)	128,400		6,420	680	4,365,600	16,371,000
	Replacement fill	138,000		6,900	100	690,000	2,587,500
Totals			0	15,705		6,677,400	25,040,250

Notes:

1. All tonnage based on EPA FS Table 2-5 Summary of Volume Estimates with Lead = 400 mg/kg
1. All impacted materials transported to hazardous disposal facility in Yukon, Pennsylvania (off-site option).
2. Import fill assumed to be within 50-mile range and equals tonnage to be disposed off-site or contained (except MC materials in on-site containment option).
3. Tonnage based on volume excavations and tons/cy multipliers. (sediment = 1.7 tons/cy, soil = 1.5tons/cy, source = 4.3 tons/cy)
3. Assume on-site containment area approximately 5 acres. 2' height of containment cover soils; 1' containment liner soils.
4. Off-site trucking 20 tons /truck. On-site trucking 40 tons/truck.
5. Miles calculated on round trip of fully loaded trucks and return trip of empty trucks
6. Carbon Dioxide Equivalent conversion factor (22.5 lbs per gal) was attained from EPA's "Methodology for Understanding and Reducing a Project's Environmental Footprint"
7. Assume Six miles per gallon used for diesel trucking.



Attachment C-3

Traffic Accidents Facts and Statistics

State of New Jersey Department of Transportation Crash Records

<http://www.state.nj.us/transportation/refdata/accident/pdf/crashrate.pdf>

ROUTE	2002 RATE	2003 RATE	2004 RATE	2005 RATE	2006 RATE	2007 RATE	2008 RATE	2009 RATE	2010 RATE	2011 RATE
1	3.80	3.66	4.35	4.04	3.86	3.67	3.60	3.53	3.66	3.84
1B	4.56	4.46	3.66	2.91	3.51	2.64	2.53	1.60	3.14	4.21
1T	8.75	4.91	4.81	3.64	0.68	0.38	1.12	1.14	2.18	3.66
3	2.68	2.38	2.66	2.49	2.24	2.70	2.62	2.68	2.52	3.17
4	3.28	3.41	3.74	3.34	3.22	3.19	3.18	3.15	3.39	3.24
5	8.48	6.69	7.93	6.34	4.95	5.00	4.82	6.11	5.06	4.95
7	5.53	5.96	9.17	8.11	7.27	7.29	7.99	7.66	7.54	9.53
9	3.28	3.68	3.85	3.66	3.66	3.64	3.64	3.99	3.85	3.71
9W	3.64	3.85	3.87	3.96	3.69	4.15	4.61	3.58	3.66	4.11
10	3.65	3.36	3.52	3.34	3.09	3.41	3.12	3.33	3.51	3.70
12	3.29	2.81	3.35	3.37	2.18	3.13	2.62	2.68	2.59	2.51
13	1.95	0.65	0.97	1.15	1.15	1.92	2.30	2.31	1.15	1.15
15	2.22	2.16	2.13	1.91	1.88	2.24	2.23	1.96	2.03	1.99
17	2.13	2.29	2.40	2.17	2.22	2.44	2.12	2.37	2.39	2.23
18	2.18	2.39	2.87	2.69	2.57	2.53	2.48	2.23	1.91	2.04
19	0.98	1.68	1.96	2.02	1.58	2.18	2.02	1.89	1.92	1.37
20	3.21	3.72	5.33	4.38	4.62	4.59	4.41	3.93	3.55	4.03
21	3.51	3.70	4.79	3.69	2.66	2.09	3.94	3.54	3.79	3.42
22	3.26	3.17	3.44	3.42	3.42	3.30	3.12	3.20	3.44	2.97
23	2.69	2.66	2.97	2.84	2.95	2.58	2.82	2.85	2.75	2.80
24	2.15	1.60	1.85	1.94	1.73	2.12	1.81	2.18	1.86	2.27
26	5.58	5.06	6.66	5.59	3.90	5.05	5.49	7.28	5.00	4.28
27	8.01	7.43	8.15	7.45	7.19	7.44	7.50	6.59	6.27	7.33
27Z	N/A	N/A	N/A	N/A	N/A	N/A	5.05	6.75	3.80	6.75
28	8.33	7.88	9.35	7.25	7.17	7.28	7.52	7.34	7.30	7.65
29	2.38	2.47	2.70	2.14	2.12	2.11	1.99	1.96	1.74	1.88
30	3.30	3.33	3.54	3.61	3.53	3.59	3.39	3.58	3.30	2.92
31	2.82	3.00	3.45	3.34	3.10	3.25	3.27	3.27	3.07	3.02
32	5.93	4.87	5.85	5.48	4.48	3.84	3.74	3.75	2.92	3.29

ROUTE	2002 RATE	2003 RATE	2004 RATE	2005 RATE	2006 RATE	2007 RATE	2008 RATE	2009 RATE	2010 RATE	2011 RATE
33	4.18	3.42	4.15	3.94	3.67	3.46	3.66	4.32	3.95	3.89
33B	3.65	2.94	2.24	3.95	2.44	2.65	2.51	2.28	2.49	2.83
34	2.46	2.10	2.40	2.45	2.34	2.39	2.31	2.62	2.58	2.52
35	4.54	5.06	5.52	5.52	5.23	5.54	5.25	5.38	5.37	5.22
36	3.00	3.22	4.19	4.45	3.98	3.95	4.14	3.94	4.18	3.83
37	4.02	3.74	3.64	4.05	4.00	3.85	3.61	3.86	3.89	4.53
38	3.00	2.65	3.09	3.05	3.06	3.11	3.18	3.46	3.23	3.37
40	2.95	2.93	3.32	3.03	3.05	3.16	2.71	3.07	2.72	2.45
41	3.37	4.13	3.83	3.20	3.04	3.20	3.42	3.71	4.17	3.68
42	4.71	2.04	2.35	2.53	2.42	2.55	2.41	2.80	2.29	2.18
44	1.65	2.03	2.39	2.92	2.79	3.01	3.01	3.28	2.52	3.01
45	3.23	4.21	4.93	4.16	4.26	4.45	4.47	4.26	4.89	4.87
46	4.22	3.62	4.03	3.91	3.77	3.66	3.49	3.48	3.46	3.42
47	3.57	3.41	4.01	3.70	3.68	3.46	3.66	3.95	3.50	3.40
48	3.08	2.72	2.98	1.46	2.65	1.06	2.12	3.05	2.79	2.79
49	3.34	3.09	3.59	3.10	2.84	2.87	2.78	2.88	2.59	2.53
50	2.31	2.84	2.78	2.93	2.75	3.23	2.76	2.81	2.47	2.59
52	1.50	0.60	2.11	1.87	1.64	1.60	2.35	1.29	1.29	1.60
53	6.22	4.17	6.02	5.66	4.59	4.72	5.05	4.25	4.55	4.47
54	2.71	3.49	4.01	3.06	3.04	2.35	1.96	2.31	2.58	2.47
55	0.74	0.92	1.00	0.96	0.87	0.88	0.90	0.95	0.96	0.97
56	2.19	1.50	1.74	2.17	2.99	2.31	2.92	2.14	3.10	2.93
57	4.29	2.00	2.73	2.36	2.74	2.58	2.85	2.93	2.97	2.92
59	3.39	1.69	0.00	0.00	3.19	3.19	0.00	3.19	3.19	7.97
63	7.86	9.89	11.23	9.26	9.34	8.75	6.73	8.80	8.92	9.76
64	2.40	1.68	5.43	6.71	5.45	5.87	7.52	3.77	7.13	2.51
66	1.93	1.58	2.90	5.45	5.28	5.21	4.55	5.34	4.74	4.49
67	9.00	5.58	9.90	10.45	10.51	11.82	10.76	9.62	8.38	11.00
68	2.21	1.38	2.42	2.20	1.85	1.97	1.93	2.01	2.48	1.85
70	3.77	3.57	3.88	3.36	3.60	3.78	3.70	3.48	3.48	3.54
71	6.47	4.87	5.28	6.37	4.74	5.78	4.91	4.67	5.22	5.43

ROUTE	2002 RATE	2003 RATE	2004 RATE	2005 RATE	2006 RATE	2007 RATE	2008 RATE	2009 RATE	2010 RATE	2011 RATE
72	3.38	3.08	2.82	2.22	1.30	2.23	2.00	2.35	2.55	2.25
73	2.64	2.64	2.76	2.57	2.39	2.65	2.62	2.56	2.49	2.65
76	6.53	4.25	4.77	4.30	4.93	5.16	4.34	4.50	4.06	3.82
77	4.40	3.91	4.88	4.07	3.77	3.61	4.11	4.23	4.23	4.38
78	1.47	1.50	1.59	1.44	1.39	1.59	1.27	1.46	1.32	1.27
79	4.42	4.70	4.98	3.85	3.77	4.09	4.19	4.19	4.24	4.12
80	1.75	1.69	1.68	1.76	1.62	1.77	1.67	1.75	1.61	1.80
81	0.00	0.23	0.22	0.00	0.11	0.44	0.33	0.44	0.11	0.44
82	8.24	8.66	9.35	11.78	12.24	10.83	9.91	9.73	10.09	10.05
83	3.21	1.17	2.43	2.61	1.79	1.63	1.46	1.63	2.12	2.12
87	1.17	2.61	3.34	2.42	3.16	2.61	2.88	1.29	1.66	2.57
88	6.94	7.60	8.44	6.00	6.51	6.17	6.02	6.03	5.46	5.14
90	0.79	0.29	1.33	1.86	0.80	1.33	1.41	1.95	1.51	1.77
91	2.27	2.64	2.90	3.09	3.18	4.36	3.63	2.18	3.09	2.18
93	10.16	6.41	6.73	8.15	6.85	6.39	4.97	5.80	6.61	6.53
94	3.19	3.09	3.29	3.85	3.33	3.27	3.42	2.89	3.20	3.38
95M	N/A	N/A	N/A	N/A	1.07	1.32	1.22	1.45	1.41	1.37
109	5.56	3.35	2.78	3.04	9.41	6.95	9.99	6.54	7.36	5.52
120	3.05	2.46	6.41	2.84	3.15	3.60	3.00	2.93	2.12	1.90
122	1.44	2.53	11.80	9.40	3.14	4.93	3.73	4.04	4.04	4.34
124	15.95	9.59	4.28	5.41	9.61	9.84	8.88	9.04	8.33	9.54
129	3.71	4.45	3.36	3.15	4.98	6.13	4.68	3.94	4.15	5.92
130	2.89	3.14	1.38	1.75	2.99	2.98	2.71	2.87	2.91	3.08
133	N/A	1.01	3.08	2.48	1.66	1.57	1.75	1.38	1.20	1.94
138	1.80	2.45	6.89	7.59	2.95	2.55	3.05	2.86	2.75	2.75
139	0.10	3.35	15.75	9.78	7.97	5.30	6.00	7.22	6.17	4.65
139U	6.28	17.30	9.50	10.81	0.30	6.62	4.20	5.11	5.57	14.89
140	12.67	12.86	2.02	4.03	10.81	11.24	8.19	8.22	9.51	6.92
143	0.51	1.01	1.23	0.73	2.04	2.01	4.02	2.01	7.05	4.03
147	1.65	0.97	0.86	0.75	1.10	0.78	1.05	0.50	0.82	0.60

ROUTE	2002 RATE	2003 RATE	2004 RATE	2005 RATE	2006 RATE	2007 RATE	2008 RATE	2009 RATE	2010 RATE	2011 RATE
152	0.14	0.32	0.86	0.75	0.89	0.75	0.75	0.96	0.75	1.02
154	4.40	5.74	6.02	5.54	5.64	5.54	4.34	4.45	5.93	5.74
156	12.09	28.22	17.42	19.36	19.73	15.97	12.18	12.21	13.15	17.85
157	4.01	8.53	3.55	4.29	3.86	2.79	4.06	3.00	4.08	3.65
159	0.00	0.33	0.55	1.00	1.77	2.99	2.32	1.88	2.99	2.21
161	0.00	2.24	2.39	4.69	3.65	4.35	3.81	5.21	4.52	6.78
162	0.00	N/A	N/A	0.74	0.00	0.00	0.00	2.31	3.08	2.31
163	0.00	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
165	4.73	9.46	18.88	5.65	4.85	10.50	6.44	4.04	9.59	10.50
166	5.58	8.36	7.71	7.89	7.41	5.98	7.14	6.81	7.13	6.50
167	0.00	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
168	5.77	7.39	8.17	8.16	8.02	8.45	8.65	7.79	7.03	7.21
169	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
171	23.25	11.37	11.57	6.33	3.77	7.39	9.02	8.90	7.99	7.24
172	4.83	1.39	1.16	1.86	1.63	9.06	6.95	3.95	2.73	2.18
173	3.81	5.49	4.81	3.19	3.16	3.19	3.61	3.38	1.77	3.25
175	4.09	8.92	2.74	2.90	1.74	3.48	5.78	4.74	4.21	1.58
179	2.01	1.89	4.03	1.19	1.64	1.94	1.49	1.50	2.43	2.38
181	4.34	3.81	3.82	3.07	2.87	3.03	3.33	3.34	2.83	3.18
182	7.09	6.69	9.68	9.87	9.87	9.40	9.26	9.52	7.08	9.75
183	3.87	3.68	4.23	3.70	3.88	3.98	3.04	1.85	2.50	2.87
184	7.10	9.36	11.79	9.60	8.00	8.58	7.18	7.42	6.04	4.58
185	1.62	0.39	5.88	2.75	2.36	4.33	4.31	2.75	2.75	7.47
187	1.17	2.34	16.35	1.75	15.77	15.77	8.73	N/A	N/A	N/A
195	0.91	1.00	0.93	1.14	0.97	1.19	1.00	1.16	1.21	1.05
202	2.89	2.72	2.90	2.77	2.99	3.09	2.97	2.89	3.10	3.29
206	3.14	3.49	3.51	3.47	3.29	3.33	3.39	3.52	3.61	3.54
208	0.86	1.09	1.21	1.31	1.01	1.23	1.14	1.23	1.27	1.40
278	0.54	0.64	2.72	1.05	1.31	2.10	2.48	3.15	2.36	2.75
280	3.01	3.13	2.78	3.01	3.03	3.10	2.75	2.86	2.67	2.81

ROUTE	2002 RATE	2003 RATE	2004 RATE	2005 RATE	2006 RATE	2007 RATE	2008 RATE	2009 RATE	2010 RATE	2011 RATE
284	2.87	3.17	2.59	2.60	2.73	2.21	2.60	3.38	2.47	3.25
287	1.65	1.47	1.40	1.41	1.36	1.45	1.34	1.24	1.30	1.39
295	1.14	1.46	1.60	1.22	1.23	1.29	1.14	1.47	1.55	1.32
322	2.89	2.17	2.04	2.42	2.10	2.48	2.38	2.31	2.01	1.91
324	3.64	N/A	0.00	3.63	3.63	0.00	0.00	10.89	0.00	0.00
439	11.54	9.83	12.44	11.29	9.78	10.11	9.72	8.48	9.46	9.26
440	3.04	2.80	2.11	2.45	2.41	2.54	2.23	2.12	2.42	2.74
495	2.74	4.31	5.60	3.22	2.92	3.46	3.80	3.83	3.07	2.34
524	N/A	N/A	2.25	0.75	2.24	2.62	1.12	0.64	0.32	0.64
676	1.42	1.72	2.09	2.36	2.45	2.75	2.80	2.40	2.34	2.28



FATAL ACCIDENT INVESTIGATION UNIT

YEAR TO DATE - VICTIM CLASSIFICATION BY COUNTY
FOR NOVEMBER 20, 2012

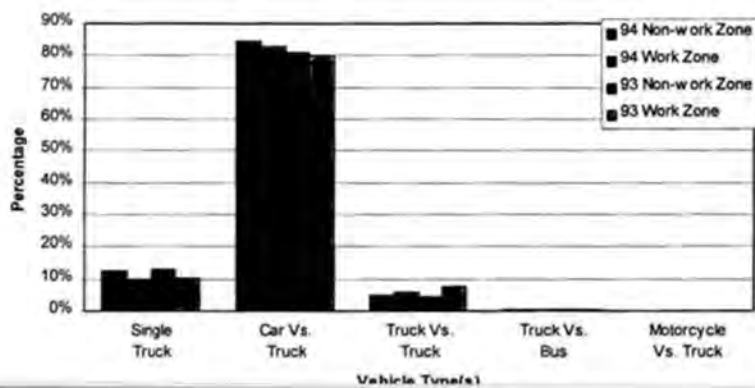
County	Driver	Passenger	Pedalcyclist	Pedestrian	Fatalities	Crashes
Atlantic	16	8	1	7	32	31
Bergen	16	6	0	8	30	28
Burlington	26	12	0	8	46	42
Camden	15	4	1	5	25	24
Cape May	5	1	0	5	11	10
Cumberland	10	2	1	4	17	16
Essex	10	7	2	19	38	37
Gloucester	13	4	0	2	19	18
Hudson	11	3	1	9	24	23
Hunterdon	2	2	1	1	6	5
Mercer	9	0	1	10	20	20
Middlesex	26	11	1	18	56	52
Monmouth	19	4	0	8	31	29
Morris	16	5	1	2	24	21
Ocean	28	5	4	5	42	40
Passaic	11	4	0	10	25	24
Salem	7	1	0	1	9	8
Somerset	7	3	0	3	13	12
Sussex	9	2	0	1	12	11
Union	12	2	0	10	24	24
Warren	8	3	0	1	12	11
Total	276	89	14	137	516	486

THIS REPORT CONTAINS STATISTICS OF FATAL MOTOR VEHICLE CRASHES THAT HAVE BEEN REPORTED TO
THE NEW JERSEY STATE POLICE FATAL ACCIDENT INVESTIGATION UNIT.

THE STATISTICS CONTAINED IN THIS REPORT ARE PRELIMINARY AND ARE SUBJECT TO CHANGE.

NL-RBS 000096

Figure 11. Comparison of Types of Vehicles Involved in Truck Accidents in Work Zones and Non-work Zones for the Years 1993 and 1994





Attachment C-4

Cost of Biofuels

INCREASED COST FOR BIODIESEL USE

From the Department of Energy report, *Clean Cities Alternative Fuels Price Report, July 2012*:

Price of diesel in Mid-Atlantic region:	\$3.80/gal	
Price of B20 biodiesel in Mid-Atlantic region:	\$4.02/gal	2% less efficient than diesel
Price of B99/B100 biodiesel in Mid-Atlantic region:	\$5.24/gal	10% less efficient

Price increase as percentage and factoring in increased fuel usage due to reduced efficiency:

For B20 fuel: % incr = $((4.02-3.80)/3.80)*1.02*100 = 5.9\%$ increase in cost

For B99/B100: % incr = $((5.24-3.80)/3.80)*1.10*100 = 41.8\%$ increase in cost

From American Transportation Research Institute report, *An Analysis of the Operational Costs of Trucking: A 2012 Update, September 2012*:

Fuel costs account for 34.6% of the per mile trucking cost in 2011. Can use B20 biodiesel without retrofitting engine if built after 1992.

From Appendix D of the Revised FS: cost to transport to haz waste facility was \$168.51/T. At 35%, cost of fuel is \$58.98/T using regular diesel.

For B20 biodiesel, increased cost is $58.98*1.059 = \$62.46$ or an increase of \$3.48/T.
At 176,000 Tons, cost increase is \$612,480.

For B99/B100 biodiesel, increased cost is $58.98*1.418 = \$83.63$ or an increase of \$24.65/T.
At 176,000 tons, cost increase is \$4.34 Million.

Exhibit D to NL's Comments

TCLP TECHNICAL REPORT

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This TCLP Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. requested Advanced GeoServices to evaluate the costs of certain elements of the total off-site removal remedy for the Raritan Bay Slag Superfund Site (the "Site"), like Alternative 2 presented in EPA's Revised Final Feasibility Study Report ("Revised FS"), compared to an on-site containment remedy like the Revised FS Alternative 5. Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site and considered our experience on the above referenced sites. It is our opinion that EPA may have substantially under-estimated the volume of material that will fail the Toxicity Characteristic Leaching Procedure ("TCLP") and will thus have to be treated prior to off-site disposal to meet RCRA land disposal restrictions. This potential underscoping of volume means the costs of offsite disposal reviewed by EPA in its decision documents may also be significantly underscoped. It is the opinion of Advanced GeoServices that when TCLP is properly evaluated, the cost of off-site disposal may be \$17 million more than what is presented in EPA's decision documents.

The volume of TCLP Lead is Significantly Higher Than Is Presented in the Revised FS, Increasing the Cost of Alternative 2 by \$17M

EPA may have significantly underestimated the cost and impact of off-site disposal from the Site. Under the EPA's preferred alternative (Alternative 2), all material that fails TCLP must be



shipped to a hazardous waste treatment facility prior to disposal. EPA has set a preliminary remediation goal (“PRG”) of 400 mg/kg lead. EPA has arbitrarily concluded that only 20% to 25% of the material that exceeds this PRG (and that therefore must be sent off-site under EPA’s preferred remedy) would fail TCLP. (See EPA Revised FS, Appendix D, Attachment A p.12 of 58). However, the available TCLP data obtained by EPA and analyzed by Advanced GeoServices below, which is the only data obtained by EPA, indicates that 100% of the material with concentrations above the PRG of 400 mg/kg lead would likely fail TCLP and under EPA’s Proposed Plan have to be treated at a Subtitle C facility prior to being disposed offsite. Since the nearest such facilities are in either Yukon, Pennsylvania or Buffalo, New York, this means that trucks leaving the Site will have to travel a minimum of 680 miles over a minimum period of three days per load. Based on EPA’s cost information provided in the Revised FS and taking into consideration contingencies, design, and management costs, this increase in offsite disposal volume would result in a \$17 million increase in the cost of EPA’s preferred total offsite remedy (Alternative 2). The breakdown of this estimated cost is presented in **Attachment D-1**. Therefore, the total cost of Alternative 2 could be \$103 million, not \$78.8 million, as set forth in the Revised FS.

Moreover, this difference significantly increases the adverse short-term impacts of the off-site disposal remedy, as described in Advanced GeoServices November 27, 2012 Remedy Implementation Negative Short-Term Impacts Technical Report, Exhibit C.

EPA should re-evaluate the costs and impacts of its preferred remedy in light of this information based on the data presented in the Remedial Investigation Report. We note this directly impacts the cost effectiveness analysis of all of the remedy alternatives presented in the Revised FS (except No Action).

Advanced GeoServices Analysis of Total vs. TCLP Lead

Advanced GeoServices analyzed the data available in the Administrative Record to understand the relationship between the total lead and the TCLP lead concentrations for soils and sediments at the Site. This relationship is significant in determining whether the excavated soils and sediments are considered hazardous or non-hazardous waste for disposal purposes under the Proposed Plan. In the Revised FS cost estimates, EPA assumed that 75% to 80% of the excavated soil and sediment depending on the area can be handled as non-hazardous waste and be disposed offsite in a Subtitle D landfill without prior treatment (and thus only 20% to 25% would have to be treated at a hazardous waste treatment facility prior to disposal). The basis of EPA’s assumptions is cited as “Per Engineer” in Attachment A to Appendix D of the Revised FS. The existing data in the Administrative Record was evaluated to see whether this assumption was valid.

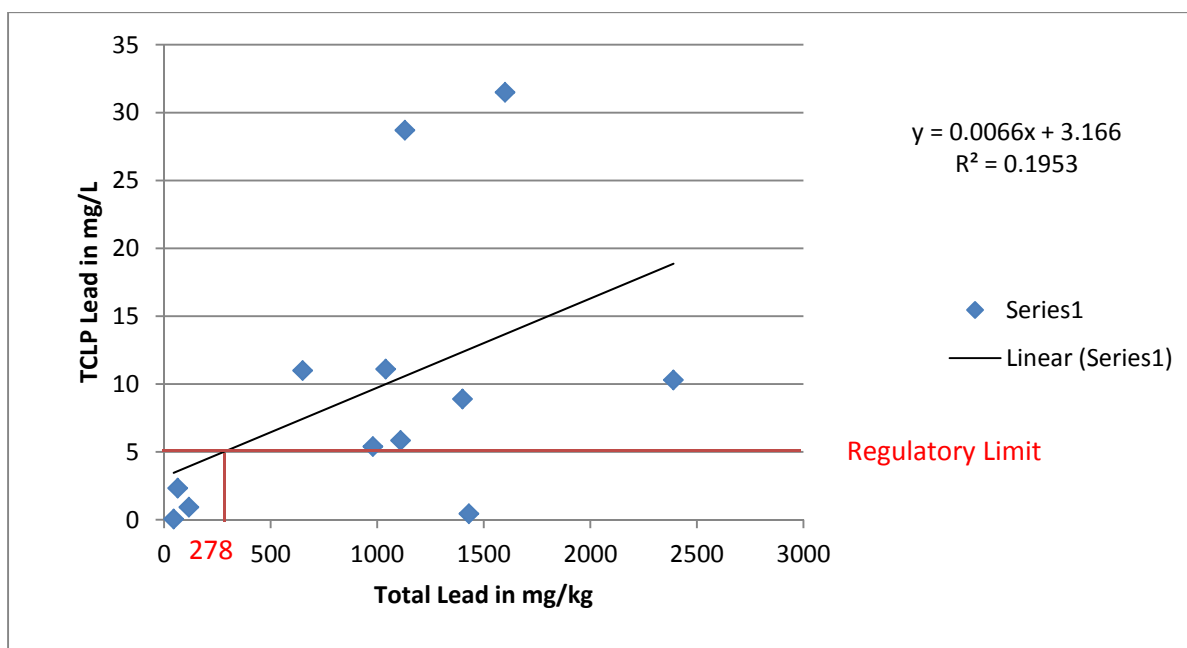
Weston Solutions analyzed 12 soil samples for total and TCLP lead and reported the data in its Summary Letter Report dated July 2009. In CDM’s Slag Characterization Study, CDM/Schnabel analyzed three samples of slag impacted sand for total and TCLP lead.



The results of all of the available testing are shown in the table below:

<u>Source</u>	<u>Total Pb mg/kg</u>	<u>TCLP Pb mg/l</u>
CDM S-1	1400	8.9
CDM S-2	650	11
CDM S-3	980	5.4
Weston RBS-01A	1600	32
Weston RBS-02A	1040	11
Weston RBS-03A	1130	29
Weston RBS-04A	45	0.0626
Weston RBS-05A	64	2
Weston RBS-06A	117	0.932
Weston RBS-09A	1430	0.451
Weston RBS-10A	1110	6
Weston RBS-S59A	2390	10
Weston RBS-S60A	14200	723
Weston RBS-S97	198000	561
Weston RBS-S98	83800	1,230

Plotting the data for samples with total lead below 5000 mg/kg shows a correlation between total and TCLP lead:





Using the regression analysis shown for the values less than 5000 mg/kg lead, the available data indicate that a total lead concentration above 278 mg/kg would fail TCLP. Because this is the only available data upon which to evaluate the amount of material that would fail TCLP, it is the opinion of Advanced GeoServices that up to 100% of the 81,000 bulk CY of the anticipated excavated soils and sediments would require handling as hazardous waste.



Attachment D-1

TCLP Cost Analysis

Raritan Bay Slag Superfund Site
Cost Increase for All Material being Characterized as Hazardous

	Material Characterized in EPA FS		
	Hazardous	Non-hazardous	Cost Total
Total Cost for T&D	\$8,727,543	\$11,588,744	\$20,316,287
Rev. FS Volume of Material (cy)	24,290	79,426	
Cost per cy for Material Handling	\$359.31	\$145.91	

	Material Characterized from Available TCLP Data		
	Hazardous	Non-hazardous	Cost Total
Volume of Material (cy)	103,716	0	
Cost per cy (see above)	\$359.31	\$145.91	
Total Cost for T&D	\$37,265,782	0	\$37,265,782

Increase due to characterization of all material as hazardous \$16,949,495
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Notes:

1. Volume of material and cost of T&D taken from EPA Alternative 2 Revised FS Appendix D
2. Characterization based on review of available EPA data

Exhibit E to NL's Comments

**LEAD MOBILITY TECHNICAL REPORT
RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Lead Mobility Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. ("NL") has asked Advanced GeoServices to provide an opinion on the mobility of the lead contained in the kettle bottom source materials (also called "slag" or "pots") located at the Raritan Bay Slag Superfund Site (the "Site") and whether the leaching tests conducted by EPA and the sampling of groundwater and surface water provides data which accurately represents current conditions at the Site and provides a sound basis for EPA's conclusion in the Revised Final Feasibility Study Report ("Revised FS") and the Proposed Remedial Action Plan ("Proposed Plan") that leaching of lead is a potential concern at the Site. Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site. It is Advanced GeoServices' opinion that EPA is relying on flawed surface water and groundwater data and leaching tests which are not representative or indicative of actual Site conditions to conclude that the lead contained in the source materials has significantly impacted surface water and groundwater at the Site. We believe that mechanical weathering is the only mobility pathway of any significance for the lead material at the Site. In the Remedial Investigation Errata document in the Administrative Record EPA recognizes the flaws in its surface water data. Likewise, EPA has previously indicated its groundwater data may also be flawed. Despite acknowledging the flaws in the data, EPA has not allowed resampling of surface or ground water or corrected its conclusions and appears to rely on the flawed data in its decision documents.



Comments on RI/FS Process and NRRB Letter to Region 2

Section 1.9 of the Revised FS discusses the mechanisms by which movement of lead from the source materials occurs, stating:

Weathering of the slag can release contaminants into the environment and create secondary sources (e.g., contaminated soils and sediment). Erosion of particulates and leaching of metals are two of the mechanisms for the release of metals into the environment.

Dissolved metals are washed into surface water via tidal flushing or storm water, or percolate into the subsurface. In the surface water, elevated dissolved phase lead, arsenic and copper were observed in all three sectors, and elevated lead was observed in Area 1. Dissolved-phase metals in groundwater travel with the groundwater flow and discharge to Raritan Bay.

The conclusions that EPA draws regarding remedial action objectives and comparison of alternatives are based on this conceptual site model. However, despite a multi-million dollar Remedial Investigation, the critical surface water and groundwater data is flawed and the leaching studies conducted do not show a propensity to leach under conditions that were intended to mimic the actual Site conditions.

NL informed EPA of the flaws in the surface water and groundwater data informally shortly after the Remedial Investigation was issued for review in January 2012, and more formally in its February 20, 2012 comment letter (from which critical excerpts are provided below).

The National Remedy Review Board in its July 5, 2012 review memorandum also expressed concern over the sufficiency of the groundwater data since only two rounds of sampling were performed (NRRB, July 5, 2012 at page 4). EPA Region 2 also acknowledged the possible flaws in the groundwater data as early as July 2011 in an email to Christopher Reitman of Advanced GeoServices saying:

The analytical results demonstrate that there is an impact to GW. However, these results could be an anomaly or a false positive as you suggest. At this time, EPA does not believe the GW is a risk driver in the absence of the slag.

Since, there is sufficient GW data to complete the RI/FS, the remedy will be managed with this anomaly in mind and EPA will continue to evaluate the GW conditions. Thus, there does not appear to be an advantage to collecting additional GW samples at this time.

(July 13, 2011 email from Tanya Mitchell to Christopher Reitman, emphasis added.)



In the Errata sheets for the Remedial Investigation (CDM Smith letter dated June 25, 2012) EPA made a clarification on how the 2008 surface water data were collected and provide revised tables noting the data as potentially biased high.

Nevertheless and despite multiple requests, EPA did not allow NL to collect additional surface water and groundwater samples, using proper procedures, which would have helped clarify this important issue. Consequently, key decisions regarding the Site remedy were made on the basis of flawed data, impacting the reliability of the resulting conclusions.

Further, Advanced GeoServices notes the leaching tests conducted by EPA and its contractors are highly variable, and in the tests designed to mimic field conditions show the slag is not mobile. Leach testings and analysis was conducted by Schnabel and they summarize the slag leaching results as follows:

Most interesting of all, the SPLP-Pb (lead) concentrations [leaching test] are non-detectable despite total metal concentrations on the order of 43,000 to 52,000 mg/kg (4.3% to 5.2 wt%). Very similar leaching behavior was observed under DIW [the Deionized Water Leach Test] extraction conditions (Table 18).

The extremely low metals leaching behavior of the crushed slag under SPLP and DIW extraction conditions stresses the importance of the influence of mineralogy, morphology, matrix effects and system pH on metals mobility. [p.22]

This testing suggests that the slag effectively binds the metals under the field conditions (i.e., pH, Eh, etc.) and the metals are not mobile in the existing environment at the Site.

Although the goal of the tests was to understand leaching behavior under a variety of conditions, we agree with EPA's contractor that overall the tests do not model field conditions within the Raritan Bay area accurately. CDM makes this clear in their report where they state:

The TCLP test is a regulatory classification test and was developed to simulate testing in landfills (low pH and organic acids). Therefore the TCLP results are not representative of conditions or metal concentrations anticipated at the Raritan Bay Slag Site. Leaching with DIW [deionized water] is more representative of rain water or sea water. However, the DIW leaching test used a crushed slag sample. The freshly exposed surfaces and high surface area in the DIW test do not represent conditions at the site. Due to these laboratory conditions, the metals concentrations from the DIW tests would typically be higher than those observed at the site. With the use of core (vs. crushed) samples the SDL tests using DIW probably most closely simulate actual conditions. However, conditions at the site typically represent an open system and the orange/rust colored precipitate observed during the SDL tests would not typically be present at the site. As previously discussed, the high



chloride content of the seawater will also potentially increase lead concentrations when compared to DIW or rain water. In all cases, the variable amounts of leaching solution at the site (seawater or rainwater) compared to the fixed amounts used in the laboratory leaching tests will also affect metal concentrations. (CDM, Slag Characterization and Leaching Evaluation, September 2011, p. 23)

Advanced GeoServices agrees that the range of tests conducted generated highly variable results and that conclusions regarding the leachability of the slag materials are difficult to draw without site-specific testing of slag materials with bay water. We also agree that the SDL tests which show the least amount of leaching are the most representative of site conditions. The variability in the results is due to differences in the specific leachate agents used in the leachability testing conducted, the variable amount of the leachate used in testing compared to actual field conditions, the uncertain impacts from chlorides, the high amount of potential mixing under true Site conditions, and the open environment within the bay at the Site.

Rather than rely on contrived and hypothetical leaching analysis in the laboratory, we believe the best data to be used for important decisions is the field data, i.e., actual groundwater and surface water data. As noted above and described in more detail below, the limited high quality characterizations do not show significant impacts in surface water or groundwater. Unfortunately, overall the groundwater and surface water characterizations are incomplete and not suitable for the magnitude of decisions being based upon them.

Details of the specific concerns with previous surface and groundwater data presented within the Remedial Investigation are provided below.

Comments on RI Data from February 20, 2012 Letter

As noted above, the problems with EPA's surface water and groundwater data collection were described in NL's February 20, 2012 comment letter on the Remedial Investigation. The relevant excerpts from that comment letter are presented below:

Most of the RI Surface Water Sampling Data is Not Representative of Site Conditions

The surface water data from the pre-RI sampling event in September 2008 which identified elevated metals is based on dissolved lead samples that were collected incorrectly and should be rejected. This means there is no accurate and representative data which indicates the slag pots are leaching to surface water. Statements and conclusions based on this data found throughout the RI therefore are unsupported and inaccurate. The most representative data comes from the April 2011 sampling event (which was conducted using appropriate methodologies) which shows that lead is not present in the dissolved fraction and thus is not leaching from the slag pots.



One issue with the September 2008 data is that the “dissolved” metals samples appear to have been preserved with acid in the field, prior to filtering. This technique was contrary to best practices, and resulted in unreliable data. The New Jersey Department of Environmental Protection’s “Field Sampling Procedures Manual,” for example, makes clear that “[w]hen filtration is performed, it must be done immediately upon sample collection and prior to sample preservation. The sample may not be transferred to the laboratory for filtration and preservation nor may it be preserved prior to filtration.” (Aug. 2005, p. 140). As noted in the Manual, “[a]cidification of an unfiltered sample will dissolve some particulate matter, thereby raising the original metals content by releasing adsorbed metals into solution.” (p. 139). That is what happened in the case of the September 2008 samples. The acid in the sample collection containers dissolved the particulate and suspended matter (containing the non-dissolved lead) and made the lead appear to be dissolved. In other words, lead that was not dissolved under natural conditions became dissolved in the samples because of the collection techniques used. This means the dissolved lead concentrations identified in the RI for the critical areas close to the slag pots (Areas 1 and 8) are incorrectly biased high.

That the September 2008 surface water data was preserved in acid without field filtering is supported by several lines of evidence:

- A. The dissolved metals data from the September 2008 sampling event provided in Attachment A shows the dissolved and total lead concentrations are essentially the same. However, the dissolved concentration should be less because the suspended fraction has been removed. This anomaly was noted in the RI report in Section 4.3.2.1, but was incorrectly attributed to non-homogeneity in the samples without consideration of either (1) the faulty sampling techniques, or (2) the combination of “activity-based” samples with non-biased sample results (which is discussed in more detail below).*
- B. The description of the field collection within the January 2009, Weston Solutions, Inc. “Summary Letter Report, Raritan Bay Slag, Old Bridge and Sayreville, New Jersey” (provided in Attachment B) does not describe field filtering. Subsequent sampling summary reports do specifically call out the field filtering of surface water analyzed for dissolved lead, confirming that the absence of a reference to field filtering in the September 2008 sampling event means that it was not performed. Moreover, results from those subsequent sampling events show significantly lower concentrations of dissolved lead and other metals relative to totals.*



- C. *Likewise, the field notes provided as Attachment C also do not describe field filtering of the surface water samples collected during the September 2008 sampling event, again confirming that field filtering was not performed.*

A second issue with the surface water sampling data arises from the fact that certain samples were intentionally agitated to place sediment into suspension (called "activity-based" samples) prior to placement into sample containers, thus increasing the lead content. The problem is that this difference in sampling techniques was not taken into consideration in evaluating the data in the RI and the Risk Assessments. When this data was used in the RI and the Risk Assessments, no reference or note was added regarding the special nature of the samples and the resulting intentionally high bias. Instead, it appears that the activity-based samples were considered alongside the other samples as if they were collected using the same techniques and represented the same Site conditions. In other words, it appears that the fact that certain samples were activity-based was inadvertently lost when the data was incorporated into the RI analysis.

These deficiencies are significant for the following reasons:

- *First, all of the data from the RI surface water sampling for total and dissolved lead collected in this area in Fall 2010 was rejected during data validation. Samples taken in April 2009 were taken from areas where slag is not present. So, with the September 2008 dissolved lead data being flawed as described above, this means no accurate and representative surface water data were used in the RI to assess the impact of slag pots in the Seawall and Western Jetty areas of concern. In other words, the conclusions set forth in the RI are completely without supporting data.*
- *Second, not only are the RI conclusions not supported by data, those conclusions (as well as those in the Human Health and Ecological Risk Assessments) likely are affirmatively wrong. The conclusion that the slag pots are leaching into the surrounding ocean at high concentrations is based upon the September 2008 data showing high lead levels in the surface water. However, as discussed above, all of the samples are biased high, providing an inaccurate and misleading picture of how much lead is dissolved in the surface water under natural conditions.*
- *Third, this misleading picture of actual Site conditions based upon the biased-high data appears to be driving the USEPA's conclusions in the RI and Risk Assessments as to the risks and*



pathways of concern. Furthermore, although the FS has not yet been issued, informal conversations with USEPA personnel suggest that the USEPA is forming remedial action preferences based upon its perceptions as to the leachability of the lead in the slag pots. An incorrect perception as to the leaching potential of the slag pots could lead the USEPA toward a preference for remedial actions that are much more time consuming, expensive and disruptive than necessary to protect public health and the environment.

Samples collected in April 2011 from Area 2 appear to have been collected properly and without agitation. However, those samples, although reported in the RI, were collected too late to be included in the risk assessment or other data evaluation in the RI. Those sample results show much lower total lead than the “activity-based” samples (3.8 ug/L as compared to 1450 ug/L), and the dissolved lead concentrations are all below the detection limit in the April 2011 data set. This data set, albeit very small (five samples with one field duplicate) for such a critical issue, is the only valid data set available to assess the actual impact of the slag pots on the surface water, but it was not used at all in the data analysis in the RI. That the dissolved lead concentrations in surface water near the slag pots is low makes sense. Our experience at other sites has shown that the slag pots are inert, and do not leach unless exposed to acidic or basic environments. The pH of the ocean water near the Site was measured at 7.02 – essentially perfectly neutral. Under such conditions, leaching of lead from the slag pots would not occur.

Additional data should be collected to understand the actual surface water conditions in the areas in question. NL proposes to collect 10 new surface water samples from near the Seawall. The samples will be collected in accordance with best practices (including field filtering prior to preservation) to avoid the problem that rendered the September 2008 data faulty. NL can collect the samples at the same time that NL accesses the Site for the test pit study. We believe additional surface water data will demonstrate the slag pots are inert and are not leaching into the surrounding areas, which will significantly alter the evaluation of the risks posed by the slag pots and what remedies may be necessary to protect human health and the environment. But regardless of what the additional sampling shows, having reliable data to support the conclusions that will be drawn regarding the risks and remedies at the Site is essential.

Groundwater Sampling Data Also is Not Representative of Site Conditions

Turbidity may be creating false positives for lead in groundwater, thus mischaracterizing groundwater conditions at the Site. Although lead in groundwater does not drive Site risks, it directly and fundamentally impacts the Conceptual Site Model which will be the basis of multi-million dollar decisions



on the need for a bottom liner and/or treatment to reduce Site risks. Our previous experience on over ten similar sites is that lead in the form of slag and slag pots is inert and does not leach to groundwater unless acidic or basic conditions are present. We believe additional sampling of groundwater should be conducted and this sampling should include both total and dissolved lead and other metals to understand whether the extreme expense associated with treatment or a bottom liner would actually provide any risk reduction at all at the Site.

NL previously brought this turbidity issue to the attention of the USEPA, and USEPA acknowledged the possibility of issues with the reliability of the data. We have experienced very similar turbidity related mischaracterizations and false positive readings in groundwater at the Jack's Creek and Tonolli Superfund Sites in Pennsylvania, the Gould Superfund Site in Portland, Oregon and at smelter sites in Tennessee and Indiana. On at least three of these sites, USEPA or the state oversight agency believed a lead plume existed, yet the high lead concentrations in the initial site samples were later proven to be related to high turbidity, poor well installation and/or development techniques, and/or poor sampling techniques. We believe this is the case at the RBS Site as well. The following lines of evidence suggest the total lead concentrations measured in groundwater are not due to the presence of a dissolved phase lead plume at the Site that would be indicative of the slag pots leaching:

- Well MW-10D is located immediately adjacent to the Seawall, as shown on Attachment D, in an area known to have high concentrations of lead in the pots and the underlying soils. Well MW-10D had lead concentrations of 18.1 ug/l and 79.5 ug/l. It is our experience that despite all the precautions taken during drilling, minor levels of cross contamination are almost always driven down during well installation activities. This likely is from soil/sediment on the auger's flights and may also be from materials on the spoons driven to collect samples. The extremely low concentrations of lead measured in groundwater could be created by just 1 part per million lead in soil from the overlying soils being driven downward during well installations and becoming entrained in a turbid groundwater sample. This would cause a spike of the groundwater which exceeds the standards being used at the Site.*
- Turbidity readings during development of MW-10D were recorded as ER2 or ER3 on the Well Development Record from October 28, 2010 provided as Attachment E. We believe this code used by the field technician indicates there was an error reading the turbidity because it exceeded the instrument range. When the well was*



sampled the first time on January 5, 2011, the turbidity could not be reduced below 50 NTU and when the well was resampled on April 6, 2011, the turbidity could not be reduced below >999 NTUs as shown on Attachment F. These well development and sampling records indicate the water had high turbidity, and the reported lead results should not be considered representative of the groundwater conditions. It is commonly our experience that the wells which are most difficult to develop are the wells which have the highest lead concentrations, consistent with being false positive results.

- *Well MW-10S is located adjacent to MW-10D, immediately adjacent to the Seawall. Well MW-10S had lead concentrations of 107 ug/l and 36.6 ug/l. The RI documents indicated this area has high lead concentrations in soil/sediment and the lead in sediments underlying the seawall could have easily be driven down and mobilized during well installation activities. We note that this well is screened from 7 to 17 feet below grade and several feet of impacted sediment is likely found beneath the seawall itself. This means the top of the well screen could easily be in or just below the impacted sediment in the seawall impacted area. Despite this, a bentonite filter pack seal was not placed at the top of the well screen to separate the potentially impacted sediments and the groundwater. This means development and purging activities would be prone to actually pull the overlying lead impacted soils into the well. The first sampling event had a concentration of 107µg/l lead and the second sampling event had a concentration of 36.6 µg/l lead. We believe the significant downward trend in the readings may be attributed to the additional purging activities which eliminated some of the potential to cross contamination impacts from drilling activities and helped to reduce the turbidity in the well.*
- *We also note well MW-10S had high salinity due to the ocean influence. This means groundwater in this zone would be considered a New Jersey Class III aquifer, rather than a Class II aquifer, because the water could not be used as drinking water without significant treatment. Thus, the use of drinking water action levels at this well as the screening criteria in the RI was not appropriate.*
- *Well MW-12S had a measured lead concentration of 20.4 µg/l which is slightly above the USEPA's federal Action Level for lead in drinking water. This well has impacted material above it which*



could have easily been driven down during the well installation activities and mobilized with turbidity during sampling. We note that the well is screened from 6 to 16 feet and several feet of impacted soil and slag could be found in the area. This means the top of the well screen could easily be in or just below the materials impacted with lead. Despite this, a bentonite filter pack seal was not placed at the top of the well screen to separate the potentially impacted soil and slag and the groundwater below.

- *The well sampling records indicate well MW-12S also has a high salinity due to the ocean influence and the water in this area would not be considered a New Jersey Class II aquifer, so the use of the drinking water action levels as screening criteria for this area was not appropriate.*

Lastly, Well MW-11S, identified on Attachment D, is the background well for the Site. It exceeded the Site screening level of 5 µg/l for lead with a reported lead concentration of 7.3 µg/l. Unfortunately, it was only sampled once so it is difficult to get an understanding of the natural variability of the groundwater background. However, using a factor of two to account for the natural background variability would result in a lead level of about 15 µg/l being used for screening. Using this concentration as a Site background screening level, which also corresponds to the USEPA federal Action Level for lead in drinking water (i.e., the lowest concentration which can reasonably be expected from drinking water sources at the tap), only 3 wells are found to exceed this 15 µg/l Action Level. The wells with lead concentrations above this USEPA Action Level are MW-10S (107 µg/l, and 36.6 µg/l), MW-10D (18.1 µg/l and 79.5 µg/l), and MW-12S (20.4 µg/l). As described previously, these wells had either construction or sampling technique deficiencies that caused the lead concentrations above the standard and the results are not likely representative of aquifer conditions. Also, the incorrect standard (drinking water) was applied in the RI in error as the groundwater in this area cannot be used as drinking water without significant treatment to remove its natural salinity.

In short, we believe that the existing data are not representative of groundwater conditions at the Site and do not support the need for a bottom liner or the need to treat the lead, which appears to be inert, to reduce leachability. NL believes it is critical to resample these 3 wells and the background well for total and dissolved lead to eliminate the turbidity effects and accurately characterize site groundwater before any conclusion regarding potential impacts of metals to the groundwater are reached. NL proposes to take additional samples for total and dissolved metals from each of the four above-mentioned wells. We will use best sampling practices (including low-flow purging and sampling methods) to avoid



the turbidity effects that likely impacted the previous samples. We believe that the results of the additional groundwater sampling will confirm that lead levels in the groundwater near the Seawall are consistent with background levels, and that lead from the slag pots is not leaching into the groundwater. Groundwater at the Site is only very weakly acidic (pH of between 5 and 6), which is not enough to cause leaching of lead from the slag pots.

Conclusion

EPA does not appear to have taken into account in the Revised FS or other decision documents that its surface water and groundwater data is likely flawed and there is no reliable data that can serve as the basis for a conclusion that the lead source materials at the Site are actually leaching into surface or groundwater. Indeed, the few reliable data that are available indicate that despite being uncontrolled in the environment and subject to wave action for over 40 years, the lead in the source materials is only mobile by way of mechanical weathering. It is not leaching to surface or groundwater even in its current state. EPA must collect representative and reliable data to the extent it will rely on that data for critical remedy decisions.

Exhibit F to NL's Comments

PRINCIPAL THREAT WASTE TECHNICAL REPORT

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Principal Threat Waste Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. asked Advanced GeoServices to provide an opinion with regard to whether EPA has properly designated the material at the Raritan Bay Slag Superfund Site (the "Site") as "principal threat waste." Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site and the EPA principal threat waste guidance. It is Advanced GeoServices' opinion that EPA did not conduct a proper principal threat waste analysis in either the Revised Final Feasibility Study Report ("Revised FS") or the Proposed Remedial Action Plan ("Proposed Plan") and classifying the Site materials as principal threat wastes is a misapplication of EPA guidance. Further, and more importantly, EPA improperly identified all the materials above the clean-up level at the Site as principal threat wastes. This is inconsistent with EPA guidance and does not take into account the unique characteristics of the source material at the Site. This improper analysis from the Revised FS was carried over into the Proposed Plan.

In its decision documents, EPA designates all material at the Site that is subject to removal or containment under the various remedial alternatives (i.e., all slag, battery casings and soil or sediment containing greater than 400 mg/kg lead) as "principal threat waste." This characterization is incorrect and inconsistent with EPA guidance on principal threat waste.



In “A Guide to Principal Threat and Low Level Threat Wastes” (OSWER document #9380.3-06FS dated November 1991), EPA defines principal threat wastes as “those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.” The guidance goes on to state:

Determinations as to whether a source material is a principal or low level threat should be based on the inherent toxicity as well as a consideration of the physical state of the material (e.g., liquid), the potential mobility of the wastes in the particular environmental setting, and the lability and degradation products of the material...The identification of principal and low level threats is made on a site-specific basis. In some situations, site wastes will not be readily classifiable as either a principal or low level threat waste, and thus no general expectations on how best to manage these source material of moderate toxicity and mobility will necessarily apply. [NOTE: In these situations, wastes do not have to be characterized as either one or the other. The principal/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification.] (EPA, 1991, A Guide to Principal and Low Level Threat Wastes, p. 2)

The analysis that EPA conducted in the Revised FS does not meet the standard laid out in the guidance document and does not accurately characterize the risks associated with the Site materials. The kettle bottom source material (also called “slag” or “pots”) and battery casings at the Site are solid; they do not produce liquids nor do they degrade with time. Their threat and potential to impact human health and the environment is derived first and foremost from direct exposure/contact with the high concentrations of lead, and the mobility of the lead is derived from mechanical erosion due to weathering and wave action. These materials have been present at the Site for over 40 years, fully exposed to the elements and they have maintained their essential physical integrity overall. See November 27, 2012 Advanced GeoServices Lead Mobility Report for more information on the mobility of lead at the Site. EPA’s risk assessment shows that current risks at the Site, even with this material totally uncontrolled, are low. Moreover, in the Revised FS, EPA admits that slag and lead-impacted material can be safely contained in a manner that would be fully protective of human health and the environment and would be effective and permanent over the long term. See Revised FS §§ 4.5.1, 4.5.3.

The inherent threat associated with the Site materials is directly related to the material’s lead concentrations. While the 1991 guidance states that there is no “threshold level” of risk established to identify principal threat waste, in later guidance, *Rules of Thumb for Superfund Remedy Selection* (OSWER document #9355.0-69 dated August 1997, p 11), EPA states “a general rule of thumb is to consider as a principal threat those source material with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios.” The 400 mg/kg PRG established at the Site is based on residential exposures, which is even more stringent than what was considered as a reasonably anticipated future land use in the Human Health Risk Assessment where the future land uses at the Site were considered recreational, trespassing, and worker exposures.



EPA guidance on principal threats specifically indicates that not all source material should be considered principal threat waste. EPA's principal threat guidance states: "treatment for all waste will not be appropriate or necessary to ensure protection of human health and the environment, nor cost effective." (EPA, 1991, A Guide to Principal Threat and Low Level Wastes, p.1). At the Jack's Creek Superfund Site in Pennsylvania, similar to the RBS Site, EPA Region 3 initially classified all materials above an arbitrary concentration of 400 mg/kg as principal threat wastes. In its review of EPA's proposed plan at this site, the National Remedy Review Board ("NRRB") (*memo from Bruce Means to Thomas Voltaggio dated September 6, 1996*) commented:

*"Specific concerns [identified by the NRRB] include the following elements that were not clearly defined: site specific remedial action objectives (**including a clear rationale for determining a principal threat level for lead in soils above which treatment is necessary**), [emphasis added] and current and future impacts on groundwater. These concerns along with other recommendations are described below.*

*First, the Region should clarify the rationale for how contamination will be addressed in the context of site-specific remedial action objectives. For example, **if treatment in alternative nine is preferred because contaminant levels greater than 10,000 ppm lead are believed to constitute a principal threat at this site, the Region should more thoroughly explain the basis for determining this lead concentration** [emphasis added]. The Preamble to the NCP sets out a program expectation regarding the treatment of principal threats wherever practicable, and defines a principal threat "...as wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure).*

*The NRRB acknowledges that lead concentrations at the Jack's Creek Site are sufficiently, high (up to 160,000 PPM) as to constitute a principal threat at some level. **However, the Regional rationale for determining the principal threat level above which treatment is practicable and deemed necessary is unclear. Such a level should be determined on a site-specific basis and may be justified in several different ways** [emphasis added]. The Region should refer to "A Guide to Principal Threat and Low Level Threat Wastes" Superfund Publication 9380.3-06FS, dated November 1991 for additional information...It is important to remember that while the NCP expectations and the principal threat guidance support the development of alternatives, the selection of an appropriate waste management strategy is determined ultimately through the remedy selection process outlined in the NCP (i.e., all remedy selection decisions are site-specific and must be based on a comparative analysis of the alternatives using the nine criteria).*



As it initially did at the Jack's Creek Site, EPA has failed to provide a clear rationale for determining whether a principal threat exists based on any specific analysis at the RBS Superfund Site. However, even if some of the materials do qualify as a principal threat waste, it is clear that classifying all material above 400 mg/kg as principal threat waste materials is not appropriate.

As set forth above, EPA has already concluded that the material at issue can be safely contained either on-site or off-site. Based on the experience of Advanced GeoServices, this conclusion is correct because of the physical and chemical stability of the material at issue. On-site containment of similar materials has been the selected remedy at numerous sites throughout the country as described in the November 27, 2012 Advanced GeoServices On-Site Containment Cell Technical Report. If anything, the slag material at this Site is even less mobile than the lead in impacted soils and sediments that are routinely contained at Superfund Sites, including residential sites, around the country. Containment removes the direct contact threat and the potential for mechanical erosion, which are the only realistic threats associated with the Site materials. In a containment remedy, the materials would not pose a significant risk if they were exposed since any breach in the containment facility would be limited in duration such that direct contact risks would not develop and no mechanical breakdown would occur since the materials are inherently stable and they would not be exposed to wave action, the primary cause of contaminant migration demonstrated at the Site. The inherent tendency of lead to bind to soils under neutral water conditions, which are the actual conditions at the Site, would also forestall migration through the subsurface. For all of those reasons, the material that must be addressed at the Site does not qualify as principal threat waste.

Exhibit G to NL's Comments

SEPARATION TECHNOLOGIES TECHNICAL REPORT

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Separations Technology Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

The alternatives developed in the Revised Final Feasibility Study ("Revised FS") for the Raritan Bay Slag Superfund Site (the "Site") did not include any on-site or off-site treatment, other than the treatment required to meet land disposal restrictions. NL Industries, Inc. has asked Advanced GeoServices to provide an opinion on whether additional analysis should have been conducted on soil separation and treatment technologies in the Revised FS. Advanced GeoServices reviewed the documents in the Administrative Record for the Site, spoke to experts in the field of soil separation technologies, and conducted bench top evaluations of magnetic separation techniques to evaluate this issue. It is Advanced GeoServices' opinion that soil separation and washing technologies would likely work on many of the materials at the Site and additional analysis should be conducted to understand the impact of this type of treatment on the alternatives considered in the Revised FS. Successful implementation of soil washing technologies could drastically reduce the amount of material that needs to be sent off-site or contained on-site, since the 400 mg/kg lead preliminary remediation goal adopted by EPA means that only 0.04% of the material at this concentration is impacted by the lead. Separation of this 0.04% impacted fraction from the remainder of the material could drastically reduce the volume of material that must be addressed by the remedy at the Site. This type of analysis of on-site treatment technologies is a directive specified in CERCLA guidance.



EPA has apparently rejected other treatment technologies to reduce volume, toxicity, or mobility of contaminated soils or sediments, such as soil washing or mechanical separation techniques because a preliminary “sieving” analysis conducted by EPA’s contractor showed that lead slag particles were present across the gradation of the sand according to the report prepared by Schnabel (Schnabel, Characterization Report for the Development of Stabilization Approaches, September, 2011, Tables 5, 6 and 7) In other words, because there were slag particles in the coarse fraction, the medium fraction, and the fine fraction of the sands analyzed, EPA apparently assumed nothing could be done to limit the amount of lead impacted sand and all of it must be contained on-site or shipped off-site. When the NRRB raised the concern that mechanical separation techniques were not being seriously considered, EPA Region II responded:

Mechanical size separation technology was not considered because the contamination exists in both the fine fraction as well as the coarse fraction, as indicated in the fractionation results during the characterization study of the slag and contaminated sediment. (EPA Memo, NRRB Recommendations, September 17, 2012, p.6)

EPA failed to consider whether other physical separation techniques (such as “gravity separation,” “magnetic separation” or “soil washing” techniques) could be used separately or combined to reduce the volume of impacted soils and sediments that must be addressed at the Site.

Carl Seward of ART Engineering, LLC, a contractor that has successfully implemented soil washing procedures at other sites in this region, has reviewed the Schnabel report and other Site information and has concluded that this Site would actually be a prime candidate for a soil washing treatment program that could reduce the volume of material that must be addressed. Such a remedy would be consistent with CERCLA’s mandate that remedies including on-site treatment be preferred over off-site disposal remedies. See 42 U.S.C. § 9621(b).

Attachment G-1 to this Report contains a letter from Mr. Seward summarizing how he has employed this type of separation technologies at other sites and how he believes, based on his experience, that this would be a viable technology at the Site. Also attached is a letter of recommendation ART Engineering received from Ronald Naman, a Remedial Project Manager from Region 2, after ART Engineering implemented a similar program at another site in New Jersey.

We believe the Revised FS should be updated to include consideration of soil washing, a volume reduction treatment technology, or at a minimum the Record of Decision should provide for such an approach to be incorporated into the Remedial Design process. A pilot scale test may be necessary prior to remedy implementation.



Attachment G-1

Carl Seward Letter with Attachment

**ART Engineering, LLC****12526 Leatherleaf Dr.****Tampa Florida, 33626**

Phone: 813-855-9852

www.art-engineering.com

*"Technology for a
clean environment"*

October 29, 2012

Christopher T. Reitman P.E.
Advanced GeoServices
1055 Andrew Drive, Suite A
West Chester, PA 19380-4293

Re: Potential Soil Washing at Raritan Superfund Site

Dear Mr. Reitman,

ART Engineering LLC (ART) has 20+ years of experience in the use of soil separation/washing (soil washing) for a wide range of projects. ART has designed many different type soil washing projects at various Superfund Sites in US and around the world. This includes us of soil washing to remediate over 400,000 tons of material at two Superfund Sites in New Jersey: 1) King of Prussia Superfund Site in Winslow, NJ and 2) Vineland Chemical Superfund Site, Vineland, NJ. Both projects were a great success. The sandy nature of the soils in New Jersey is generally very favorable for use of soil washing.

ART has reviewed the available data regarding the Raritan Superfund Site. The data indicates this project has all the right characteristics (moderate contaminant level, large soil volume, and favorable grain size distribution with low fines content) to be a good candidate for use of physical separation based soil washing. There is no basis to say that soil washing will not be effective on this project. Previous studies characterized the sand and slag but did not do any studies on the use of physical separation methods for removal of slag particles. In order to evaluate the potential for application of soil washing at the Raritan Superfund Site, ART recommends performance of an initial soil washing treatability study. We believe the report will confirm that soil washing is a suitable technology for volume reduction of the sand/slag mixture at the Raritan Superfund Site.

The EPA Region 2 stance on soil washing has been very positive. The EPA project manager for the Vineland Chemical Superfund Site, Ron Naman, provided a letter of recommendation for ART related to the Vineland Chemical Superfund Site project. A copy of this letter is attached. We suggest that your EPA project manager for the Raritan Bay project contact Ron Naman (Direct line: 212-637-4375) to share experiences related to soil washing.

Please let us know if you have any questions or if you wish to receive additional information.

Best Regards,

Carl Seward
President

ART Engineering, LLC

NL-RBS 000128



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

February 28, 2008

RE: Recommendation for ART Engineering, LLC

To Whom It May Concern:

It is my pleasure to provide a letter/note of recommendation for ART Engineering, LLC (ART). ART has provided outstanding service to EPA Region 2 (through an Interagency Agreement with the U.S. Army Corps of Engineers) involving the Vineland Chemical Company Superfund Site in the State of New Jersey.

Vineland Chemical manufactured arsenic-based herbicides for over 40 years on a 54-acre parcel in southern New Jersey. Poor waste storage and disposal practices resulted in the contamination of on-property soil, nearby stream/river/lake sediment and groundwater with arsenic. Superfund decision documents were prepared which called for soil washing the contaminated soils and sediments to remove the arsenic contamination. The State residential soil cleanup criteria of 20 parts per million was established as the cleanup goal. EPA, through its Superfund program, encourages the development and implementation of innovative treatment technologies for hazardous waste site remediation and monitoring and measurement. After careful review, ART was selected to develop/design and assist in the implementation of the innovative soil washing remedy.

The treatment scenario was very complex. The soil washing system had to be designed to manage a broad range of arsenic levels (concentrations just above the cleanup criteria to those exceeding 10,000 parts per million) while handling a range of sandy soil media with some aggregate. The large volume of material needing treatment (initial design called for the treatment of 180,000 tons of material with the potential for future treatment of additional volumes of material) also required some special considerations.

ART's responsibilities on the project included completing a number of design studies, designing the soil washing plant, and preparing/overseeing many construction, operations and optimization aspects of the project. Some specific efforts included:

Preparing a Project Feasibility Study

Completing a Site-Specific Process Design including Process Flow Diagram and Piping and Instrument Design

Preparing Plant Design Construction and Preparation of Procurement Specifications

Preparing the Excavation, Staging and Blending Plan

Preparing Operations Plans

Supporting Plant Start-up and Commissioning

The final plant design included a system capable of operating at greater than 70 tons per hour production rate. It included sand separation, sand (chemical) extraction, soil washing, water clarification, arsenic precipitation, leachate regeneration, sand dewatering, fines thickening and filter press dewatering systems. ART also supported optimization studies and continues

its relationship with EPA by providing system operations feasibility testing for future work phases on this large long-term project.

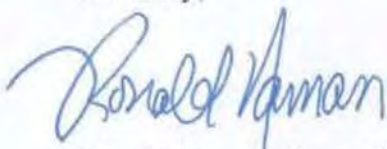
I am very pleased to note that the plant has been fully operational since 2004. Over the past four years, the soil washing plant has successfully processed over 410,000 tons of arsenic-contaminated soil/sediment. Approximately 94 percent of the material was treated to the cleanup level and returned to the site as clean backfill. The contaminated sludge from the soil washing process along with oversized material accounted for the remaining six percent. While not completely defined at this stage of the project, the anticipated cost savings for soil washing versus off-site disposal of the entire soil/sediment waste stream (as an arsenic waste) exceeds \$30 million.

In addition to being recognized as experts in their field, ART staff members (especially Erik Groenendijk and Carl Seward) were found to be easy to work with, responsive to client needs, and motivated to provide value to the project. On numerous occasions, ART was called upon to provide time-critical feedback on plant operations or planning for future work. They delivered every time.

EPA has highlighted the success of the Vineland soil washing process at numerous national meetings. The feedback on the technology (ART's design), if used under applicable site conditions, has been very positive. To date, I believe that the Vineland soil washing plant is the largest of its kind in the United States.

Overall, the completely successful operation of ART's soil washing plant design is a true testament of the firm's capabilities. Once again, I can highly recommend ART. Please feel free to contact me if you require any additional information regarding ART or its role on the Vineland project.

Sincerely,

A handwritten signature in blue ink that reads "Ronald Naman". The signature is fluid and cursive, with the first name "Ronald" being more prominent than the last name "Naman".

Ronald Naman, Remedial Project Manager
EPA Region 2 – ERRD/RSDCT

E-mail: naman.ronaldm@epa.gov

Exhibit H to NL's Comments

SLAG DISPOSAL COST TECHNICAL REPORT

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This Slag Disposal Cost Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. requested Advanced GeoServices to evaluate the costs of certain elements of the remedial alternatives for the Raritan Bay Slag Superfund Site (the "Site") presented in EPA's Revised Final Feasibility Study Report ("Revised FS"). Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site and considered our experience on the above referenced sites. It is our opinion that it is not cost effective to send the kettle bottoms for offsite disposal as contemplated by EPA since that cost is more than double the cost to contain that same material onsite.

Costs for off-site disposal of the kettle bottom material is over twice as high as containing that material on-site in a properly designed containment cell

The source materials at the Site are unique and are made up primarily of large and heavy kettle bottoms (also called "slag" or "pots"). Advanced GeoServices reviewed the cost for addressing the kettle bottoms. For the analysis, Advanced GeoServices reviewed costs for EPA's proposed Alternative 2 (off-site disposal) and Alternative 3 (on-site containment) to understand the cost difference per ton and per cubic yard of kettle bottom source materials only. For Alternative 2, the following costs were included: Excavation/picking of source materials from all sectors, transport, treatment and disposal, restoration of Margaret's Creek and operating, monitoring and



maintenance costs (OM&M). For Alternative 3, the following costs were included: excavation/picking of source materials from all sectors, Western Jetty containment cell construction, Margaret's Creek upland area containment cell construction, transportation to the cell locations and OM&M of the onsite containment cells.

The total volume of kettle bottom source materials is estimated to be 11,100 CY or 47,000 tons using EPA's conversion of 4.3 tons/cy provided on Table 2-5 of the Revised FS. In the Revised FS analysis included in Alternative 3, the material was being contained at both the western jetty and the Margarets Creek Property. Advanced GeoServices believes consolidation of the materials into one cell in the upland area is feasible and would likely be more cost-effective. However, for this analysis the costs of the cell construction for both sectors, the cost to transport from the Seawall Sector to the Margaret's Creek cell and from the Western Jetty to the Western Jetty cell, and costs associated with the O&M were analyzed.

As shown on **Attachment H-1**, on-site containment of the kettle bottom source materials is much more cost-effective than off-site disposal. The unit cost is more than double to implement EPA's proposed plan (\$296.35 per ton) to send the slag material for offsite containment rather than to contain the material on-site (\$126.56 per ton). See **Attachment H-1**.



Attachment H-1

Slag Cost Comparison

Cost Comparison for EPA FS Alt. 2 vs. Alt. 3
RBS Superfund Site

EPA FS Alternative 2 Off-Site Disposal		EPA FS Alternative 3 On-Site Containment of Source Materials	
Item	Cost	Item	Cost
Excavation/Picking of Source Materials All Sectors	\$94,935	Excavation/Picking of Source Materials All Sectors	\$94,935
Transport, Treatment and Disposal of Source Material from All Sectors	\$9,674,037	Western Jetty Cell Construction	\$551,831
Restoration of Margaret's Creek (backfill cost only)	\$20,398	Margaret's Creek Cell Construction	\$684,815
Operation Monitoring and Maintenance	\$279,000	Transport to Cell Locations	\$118,302
		Operation Monitoring and Maintenance	\$2,850,000
subtotal	\$10,068,370	Total	\$4,299,883
Contingency (20%)	\$2,013,674	Contingency (20%)	\$859,977
subtotal	\$12,082,044	subtotal	\$5,159,859
Project Management (5%)	\$604,102	Project Management (5%)	\$257,993
Remedial Design (6%)	\$724,923	Remedial Design (6%)	\$309,592
Construction Management (6%)	\$724,923	Construction Management (6%)	\$309,592
Total	\$14,135,991	Total	\$6,037,035
Cost per ton	\$296.35	Cost per ton	\$126.56
Cost per cy	\$1,273.51	Cost per cy	\$543.88

Cost difference per ton	\$169.79
Cost difference per cy	\$729.64

Notes:

1. Volume of source materials 11,100 cy (47,700 tons) taken from Table 2-5 of EPA FS.
2. Costs for item taken from EPA FS cost estimate summaries.
3. Only source material reviewed (slag and battery casings).
4. Tonnage based on 4.3 tons per cy of source materials.
5. Assume backfill of Margaret's Creek to equal removal volume (711 cy).
6. O&M costs obtained from annual and periodic costs provided in present value 30 years for each alternative.
7. Subbase improvements (\$776,867) removed from each cell construction item.
8. OM&M costs for Alternatives reduced prior to contingency, PM, RD and CM costs.
9. Cell construction is only for source materials.

Cost per ton for off-site disposal is twice as high.



Exhibit I to NL's Comments

ON-SITE TREATMENT TECHNICAL REPORT

**RARITAN BAY SLAG SUPERFUND SITE
PROPOSED PLAN**

Prepared By:



**November 27, 2012
Project No.: 2007-1973**



Introduction

This On-Site Treatment Technical Report was prepared by Mr. Chris Reitman and Mrs. Barbara Forslund and represents the opinions of Advanced GeoServices Corp. (Advanced GeoServices) on the subject matter described below. Both Mr. Reitman and Mrs. Forslund have over 25 years' experience dealing with containment issues on large sites impacted with lead and other metals. Their experience covers a wide range of areas, including analyzing and developing appropriate clean-up levels, evaluation and selection of appropriate containment technologies for specific sites, and managing civil design issues and geotechnical issues associated with proper application of containment technologies. Most of their experience with containment technologies has been on large sites managed under the RCRA and Superfund programs. Mr. Reitman was the lead design and certifying engineer on the Jacks Creek Superfund Site, Revere Superfund Site, two Removal actions completed in Collinsville, Illinois, a removal action in Atlanta, Georgia, and has completed services at the Novak Superfund Site, the Marjol Battery RCRA Site, the Tonolli Superfund Site, and three disposal impoundments that were contained in-place in Pennsylvania. In total, Mr. Reitman has been involved in the management and containment of over 2,000,000 cubic yards of metal impacted soils and waste materials. Ms. Forslund was the certifying engineer at the Gould Battery Superfund Site and Marjol Battery RCRA Site, and has overseen removal actions in Throop, Pennsylvania, Depew, New York, and Detroit, Michigan and provided services at numerous other metals containment sites. Mr. Reitman and Ms. Forslund have worked together for the last twenty years at Advanced GeoServices.

Advanced GeoServices Opinion

NL Industries, Inc. requested Advanced GeoServices to evaluate the costs of certain elements of the remedial alternatives for the Raritan Bay Slag Superfund Site (the "Site"). Advanced GeoServices has reviewed the documents provided by EPA in the Administrative Record for the Site and considered our experience on the above referenced sites. It is our opinion that EPA did not consider the substantial cost savings that can be realized if the impacted materials at the Site are treated on-site as opposed to off-site, as is currently contemplated in EPA's preferred remedy Alternative 2 (total off-site disposal). It is Advanced GeoServices' opinion that to the extent any impacted material must be disposed off-site, it should be treated on-site, not off-site, to allow disposal as non-hazardous material and to substantially reduce costs.

In the Revised FS and the Proposed Plan, EPA has unnecessarily required transport of material from the Site as hazardous waste and treatment of the material at a Subtitle C facility prior to disposal, greatly increasing the cost and time to implement the remedy. Advanced GeoServices believes any material that is to be transported off-site for disposal should be first treated on-site within the same Area of Contamination/Corrective Action Management Unit ("CAMU") to remove the toxicity characteristic. This on-site treatment would allow for disposal at a local Subtitle D facility at a significantly reduced cost. This type of on-site treatment approach is routinely performed at sites across the country where treatment is necessary. Some examples of on-site treatment of materials which failed TCLP for lead are the Jack's Creek Superfund Site,



Browns Battery Superfund Site, Tonolli Superfund Site, Gould Superfund Site and ILCO Superfund Site. On-site treatment was also conducted on soils with lead at Superfund Removal Actions conducted in Collinsville, Illinois, Detroit, Michigan, and Atlanta, Georgia.

In Section 2.2.5 of the Revised FS, EPA categorized the Site materials as D008, a RCRA characteristic waste that fails the TCLP regulatory standard for lead. Later in Section 2.7.7, in its evaluation and screening of implementable technologies, EPA considered ex-situ chemical treatment to reduce the mobility of lead as an implementable technology and stated “under this process option, contaminated materials from all areas of the site will be excavated/dredged and treated in designated remediation target areas and then either disposed of at off-site facilities, placed in the containment structures on-site or consolidated and placed back in the excavated/dredged areas.” It is in the following section, Section 2.7.8.2, where EPA appears to incorrectly assume that any material that is TCLP hazardous must be disposed of in a Subtitle C landfill or be treated at an off-site facility prior to disposal. Elsewhere in the text of the Revised FS (e.g., pg. 4-20), EPA states that the material has to be both treated and disposed at Subtitle C facilities; however the cost estimates in Appendix D of the Revised FS have the material being treated at a Subtitle C treatment facility and then disposed in Subtitle D cell at the same facility in Yukon, PA. With this presumed off-site treatment remedial approach, EPA is precluding the option of treating the materials on-site to remove the toxicity characteristic prior to transport and disposal. This ignores routine practice at Superfund sites in New Jersey and elsewhere in the United States and unnecessarily increases costs.

This approach is also in direct conflict with CERCLA directives, which have a preference for such treatment to occur prior to removal from a site. Section 9621(b)(1) of CERCLA states: “The offsite transport and disposal of hazardous substances or contaminated materials without such treatment [i.e. treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants] should be the least favored alternative remedial action where practicable treatment technologies are available.” 42 U.S.C. § 9621(b).

Further, on-site treatment is much more cost-effective than what EPA has proposed because it would allow for disposal at a Subtitle D facility locally within the state of New Jersey. On-site treatment could be performed within the controlled and secured areas of the Site. Following treatment, the materials would be non-hazardous, and no further treatment would be required to meet land disposal restrictions prior to disposal at a Subtitle D facility.

The most significant cost components of off-site disposal are the transportation costs and landfill fees associated with trucking the material to a Subtitle D facility versus a hazardous waste treatment facility in Yukon, Pennsylvania. By transporting to a Subtitle D facility instead of a hazardous waste treatment facility, one truck containing impacted material would be able to dispose of that material locally, which would mean a decrease from at least 680 miles roundtrip to the treatment facility near Pittsburgh, for example, to most likely less than 100 miles roundtrip to a Subtitle D facility in New Jersey. This would result in a reduction from approximately 6.6 million miles to 1.5 million truck miles driven during the project. In addition, the fee charged per ton to transport and dispose at a Subtitle C facility is substantially higher than the fee per ton



to transport and dispose at a Subtitle D facility. Advanced GeoServices calculates that based on transportation costs and facility fees only, it costs more than twice as much to send the material to a Subtitle C treatment facility as hazardous waste where it will then be treated as opposed to treating the material on-site and sending the resulting non-hazardous material to a non-hazardous Subtitle D facility. Transportation and disposal at a Subtitle D facility is estimated to be \$90/ton as opposed to transportation to a hazardous waste treatment facility and subsequent disposal that is located much farther away from the Site. That cost is \$213/ton, an increase of over 136%. See **Attachment I-1**.

There are other benefits to treating the material on-site so it can be disposed at a Subtitle D facility located much closer to the Site. The remedy would require many fewer truck miles, thereby reducing the carbon footprint associated with remedy implementation as well as the risk of traffic accidents and associated fatalities or injuries. See November 27, 2012 Advanced GeoServices Off-Site Disposal Negative Short Term Impacts Technical Report provided as Exhibit C for more information on these types of impacts. This also keeps the material within the same state as the Site as opposed to transferring the responsibility to another state.

Furthermore, on-site treatment is expected to reduce the amount of time required to complete the remediation project. As explained in the November 27, 2012 Advanced GeoServices Remedy Implementation Negative Short Term Impacts Technical Report, this is because the amount of material a Subtitle C facility could accept in a day is limited based upon truck availability and regulated daily capacity of the treatment facility and the landfills. This could result in a backlog that delays the project. Treating material on-site to allow it to be disposed of at a Subtitle D facility would also allow the use of multiple disposal facilities, reducing the potential for delay caused by a disposal backlog at any particular facility.



Attachment I-1

Material Transportation and Disposal

Raritan Bay Slag Superfund Site
Cost Difference for Transport and Disposal to Local and Yukon, PA Disposal Facilities

Local Transportation and Disposal			Yukon Transportation and Disposal			Differential per Ton
Local Transportation (per ton)	Local Disposal Subtitle D (per ton)	Total Local Trans/Disposal Cost per Ton	Haz Transportation Yukon Facility (per ton)	Haz Disposal Yukon Facility (per ton)	Total Yukon Trans/Disposal Cost per Ton	
\$25	\$66	\$90	\$169	\$44	\$213	\$123

Notes:

1. Unit rates obtained from EPA FS Alternative 2 Cost backup (Appendix D) .
2. Using the following cost descriptions, the local transportation is estimated to be \$25 per ton: \$275.74 per load (22 tons per load) is \$12.53 per ton (USR HAUL-NHZ-03), Live load 153.19 per load (22 tons per load) is \$6.99 per ton (USR HAUL-NHZ-01), Liner is \$114.80 per load (22 tons per load) is \$5.22 per ton (USR HAUL-NHZ-02) Contract Cost Summary pages 67 and 68.
3. Local disposal unit rate obtained from USR DISP-NHZ-01 Contract Cost Summary page 68.
4. Yukon transportation cost unit rate obtained from USRHAUL-HZ-01 Contract Cost Summary page 68.
5. EPA FS Yukon disposal cost unit rate includes both treatment and disposal. This analysis assumes approximately 41% of \$106.54 (USR DISP-HZ-01) is for disposal or \$44.38 per ton; Contract Cost Summary page 68. This is consistent with recent discussions with Yukon representative.

Exhibit J



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Courtney J. Riley
Vice President, Environmental Affairs
(972) 448-1466

VIA EMAIL AND OVERNIGHT MAIL

May 22, 2012

Ms. Tanya Mitchell
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007

Re: ***Raritan Bay Slag Superfund Site***
Engineering Evaluation/Cost Analysis

Dear Ms. Mitchell:

NL Industries (NL) submits the enclosed Engineering Evaluation/Cost Analysis (EE/CA) for the Raritan Bay Slag Superfund Site (Site), prepared by Advanced GeoServices Corp. on behalf of NL.

As you know, NL has, with the encouragement and guidance of the U.S. Environmental Protection Agency (USEPA), been working to prepare the EE/CA for the past several months. That process involved a tremendous amount of work by Advanced GeoServices, NL's risk assessment consultant Gradient Corp., and NL's in-house personnel. More than 1000 pages of reports and sampling data were reviewed and analyzed, including both the Remedial Investigation (RI) and Feasibility Study (FS). Then, hundreds of hours were spent analyzing various removal action alternatives and the equipment, materials and logistics of implementing such alternatives to evaluate the effectiveness, implementability and cost of each alternative. Included within the evaluation of the implementability of the removal alternatives was an analysis of the impact to the community in terms of factors such as duration of the work, creation of traffic congestion, dust, noise and exhaust emissions, and risk of harm to the public.

The enclosed EE/CA reflects the results of this work. You will see that NL's approach in the EE/CA is consistent with NL's recommendation in its comments to the National Remedy Review Board (NRRB) that the Site be addressed through a phased approach. The most immediate goal is to address issues in the publicly-owned, publicly-accessed area of the Site, which is the portion of the Site located in Old Bridge Township. Under any removal alternative ultimately selected by USEPA, the Principal Sources (i.e., the slag pots, battery casings, and immediately adjacent sediment and soil most impacted by the slag and casings) in the Old Bridge portion of the Site will have to be removed. Moreover, those Principal Sources drive the majority of the risk at the Site. It makes sense to focus first on the removal activities that will have the greatest impact in reducing risks at the Site, and the EE/CA is a first phase measure designed to do just that. The approach articulated in the EE/CA has the additional benefit of

NL-RBS 000143

allowing the public area of the Site, including the Old Bridge beach and park areas, to be reopened to the public as quickly as possible.

Although NL's comments to the NRRB expressed concerns regarding Preliminary Remediation Goals (PRGs) identified in the FS for certain constituents, NL elected not to revisit those concerns in the EE/CA. Instead, NL adopted USEPA's 232 mg/kg lead PRG from the FS and utilized EPA's sampling data from the RI to determine the vertical and horizontal limits of excavation for purposes of the removal alternatives evaluated in the EE/CA.

The four alternatives evaluated in the EE/CA consist of the required no action alternative, two different variations of a removal with on-Site containment, and removal with off-Site disposal. One of the on-Site containment alternatives evaluated is a new approach referred to as "Macroencapsulation." Under the standard on-Site containment approach, all of the Principal Source material would be placed in an engineered cell in the upland area of the Site and capped with a multi-layer geosynthetic and soil cover. The Macroencapsulation approach would involve relocating the massive slag pots (each weighing approximately 450 pounds) to a position behind the current seawall and on the seaward side of the Park, where they would be encapsulated with a cement-type additive, capped on the top and fully covered on the front by a restored seawall. The remaining Principal Source material (such as impacted soil and sediments – which generally have lower concentrations of contaminants) would be contained in a smaller engineered capped containment cell in the upland area of the Site.

NL has included this Macroencapsulation approach to address concerns expressed by Old Bridge residents during Community Advisory Group meetings (including concerns regarding the final height of the containment cell, cell capacity, the impact of the cell on drainage from the upland area, etc.). The Macroencapsulation approach would alleviate those concerns by allowing for a smaller upland containment cell, and one that contains materials with much lower contaminant concentrations. Moreover, the Macroencapsulation approach would provide additional protection to the Park and coastline against erosion damage from storm events. Implementation of the Macroencapsulation approach would also minimize transport and movement of excavated material within the Site, and therefore minimize dust, noise and truck emissions associated with the cleanup.

Both of the on-Site containment alternatives have the same effectiveness as the off-Site disposal remedy, provided that maintenance of the containment cells occurs. Maintenance of the containment areas over time will be standard and routine. However, the off-Site disposal alternative (in addition to costing almost twice as much) has several significant disadvantages compared to each of the on-Site containment alternatives. The off-Site disposal alternative would require at least two years to implement, and possibly much longer depending on limitations associated with truck and disposal facility availability and truck staging space at the Site or on nearby local roads. The Park and beach areas would be unavailable for public use during the duration of the project. By comparison, implementation of either of the on-Site containment alternatives would require much less time to complete (just 6 to 12 months).

Additionally, the off-Site disposal alternative would have substantial detrimental impacts to the local community associated with the trucking of materials off-Site. The off-Site disposal alternative would generate approximately 112,000 tons of impacted materials that would have to be trucked to off-Site disposal facilities and clean replacement materials trucked to the Site. This

Ms. Tanya Mitchell
May 22, 2012
Page 3 of 3

would equate to approximately 9,300 fully loaded truck trips and an equal number of empty truck trips, for a total of more than 18,600 truck trips through the community. The truck traffic to transport materials to off-Site disposal facilities would use Route 35 in the vicinity of the Site, which statistics show already is among the roadways most prone to accidents in the entire state. The local roads near the Site are particularly ill-suited for the task because of the minimal shoulders, presence of single lane bridges, and the fact that they are already overloaded with existing traffic. With trucks more likely to be involved in vehicle accidents than cars according to government statistics, the thousands of additional trucks on the road would substantially increase the chances for vehicle accidents and potentially serious injuries. The many thousands of additional truck trips would at a minimum significantly increase traffic congestion and associated delays, and would also increase noise, dust and exhaust emission pollution, all of which would detrimentally impact local businesses and quality of life of residents of the community.

Taking all of these factors into account, NL believes that the on-Site containment alternatives present the best remedial options for the Site. NL is willing to undertake the performance of either of the two on-Site containment alternatives (Alternatives 2A or 2B), as described in the EE/CA. As noted earlier, NL believes that it makes sense to remove Principal Source materials in the Old Bridge portion of the Site because doing so will accomplish the dual goals of eliminating the majority of the risks identified for the Site and reopening the Old Bridge waterfront to the public. Ideally, NL would like to start the work in 2013. However, much planning, engineering and contracting work must occur before NL could start the work at the Site. Thus, for NL to be able to begin the work in 2013, NL and USEPA will need to reach agreement on the performance of the work within the next two or three months.

NL looks forward to USEPA's response to NL's proposal, and we would be happy to answer any questions USEPA may have regarding any of the alternatives analyzed in the EE/CA.

Very truly yours,



Courtney J. Riley

Enclosure

cc: Frank Cardiello, Esq., USEPA, Region 2
The Honorable Owen Henry, Old Bridge Township
Mr. Dave Samuel, CME Associates
Christopher R. Gibson, Esq., Archer & Greiner

NL-RBS 000145



ENGINEERING EVALUATION/COST ANALYSIS

RARITAN BAY SLAG (RBS) SUPERFUND SITE MIDDLESEX COUNTY, NEW JERSEY

Prepared by:

ADVANCED GEOSERVICES CORP.

Project No.: 2007-1973

May 22, 2012



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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared by Advanced GeoServices Corp. (Advanced GeoServices) on behalf of NL Industries, Inc. (NL) for the Raritan Bag Slag (RBS) Superfund Site (Site) in Old Bridge Township (Old Bridge) and the Borough of Sayreville (Sayreville), Middlesex County, New Jersey. The Site is currently listed on the National Priorities List (NPL) and is subject to the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9601, et seq. This EE/CA has been prepared in response to a request by the United States Environmental Protection Agency (USEPA).

USEPA has extensively investigated the Site and on December 22, 2011, issued the Remedial Investigation Report (RI), which contains a Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA). On February 29, 2012, USEPA issued the Feasibility Study (FS) for the Site, which examines a range of remedial alternatives, including no action and excavation with on-Site containment and/or off-Site disposal of materials from impacted areas of the Site.

USEPA is currently in the process of developing a Proposed Plan for the Site. Under any remedial alternative ultimately selected by USEPA, the Principal Sources of lead in the Old Bridge areas of the Site will need to be removed. For purposes of this EE/CA, "Principal Sources" means Slag (defined below and consisting mostly of large, heavy hemispherical pots), battery casing fragments, and certain highly impacted soils and sediments in close proximity to the Slag and battery casings in the Old Bridge areas of the Site. The majority of risk at the Site is derived from these Principal Sources and, for this reason, removal of them as an initial action at the Site will address and eliminate a majority of the risk at the Site.

The RI and FS focus on three sectors, one of which is some distance from the other two and located in a different township. Each has its unique characteristics. These sectors have been further broken down into specific study areas as shown on Figure 1-1. The Old Bridge portion of



the Site includes the Seawall, the Areas 2 and 5 Beaches, the Park and the Margaret's Creek area. These areas are on lands owned/controlled by Old Bridge and include many public areas. The Western Jetty area of the Site is located in Sayreville on privately owned lands not accessible to the public. As explained more fully below, this EE/CA describes an interim measure designed to address those Principal Sources of lead located in Old Bridge, where removal will have the greatest impact in reducing risks at the Site.

Summary of Site Conditions

Site Location and Description

The Site is located on the shore of Raritan Bay, in the eastern part of Old Bridge within the Laurence Harbor section of Middlesex County, New Jersey. A small portion of the western end of the Site, the Western Jetty at the Cheesequake Creek Inlet, is located in Sayreville. The Site is bordered to the north by Raritan Bay and to the east, west and south by residential properties.

The Site is approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the area just beyond the Western Jetty at the Cheesequake Creek Inlet. The Old Bridge Waterfront Park occupies the eastern half of the waterfront area and is partially closed to limit public access to impacted areas. This EE/CA is focused on addressing the Principal Sources located in the Old Bridge area of the Site.

Site History

In the late 1960s and early 1970s, large hemispherical smelting kettle bottoms ("pots") weighing around 450 pounds each (Slag) were reportedly deposited on the beachfront in Old Bridge, creating a Seawall to protect an area subject to erosion. The Western Jetty at Cheesequake Creek Inlet was originally constructed in the late nineteenth century. Slag was reportedly placed on the Western Jetty during the same general time period as the construction of the Seawall.



In 2007, elevated levels of lead, arsenic, copper, and antimony were identified by the New Jersey Department of Environmental Protection (NJDEP) in the soil and sediment along the Seawall at a beach near the western end of the Seawall in Old Bridge.

In 2008 and 2009, USEPA collected and analyzed soil, sediment, water, biota, and Slag samples to characterize conditions. Analytical results indicated that elevated concentrations of lead and other heavy metals were present in the soils and sediment near the Seawall and the Western Jetty at the Cheesequake Creek Inlet. USEPA's Removal Action Branch conducted a removal action in 2009 to restrict access to the Seawall and Western Jetty by installing permanent fences and posting signs and implemented public outreach activities to inform residents and others that potential health hazards exist. The Site was listed on the NPL on November 2, 2009.

Characteristics of the Principal Sources

The Principal Sources are comprised primarily of Slag, which contains approximately 6% to 8% lead, 2% antimony, 1% copper and 0.5% arsenic. The Slag is largely in the form of pots, each weighing about 450 pounds, which are dense, solid and non-degradable. The Slag in the Seawall has been found to slowly mechanically erode when subjected to continuous exposure to the elements over a long period of time. The mechanical erosion of the Slag has impacted the soils and sediments in close proximity, and these Slag-impacted soils and sediments are also part of the Principal Sources. Lastly, the Principal Sources contain fragments of battery casings. Also present at the Site are other non-contaminated debris such as brick and broken concrete, which are not subject to action under CERCLA.

Slow mechanical erosion of the pots caused by weathering and exposure to rainfall and wave action is the primary source of Slag-related contaminants and has resulted in limited impacts to nearby soils/sands and sediments. This is evidenced by the data showing the highest concentrations of lead and arsenic in the sediments right in front of and to the west of the Seawall. Wave action suspends the Slag-impacted sediments into the water column where the sediment particles can then be carried towards the west by the long-shore current. The jetties to



the west of the Seawall intersect the long-shore current, causing the sediment particles to drop out of the water column. Heavier particles (sand-sized) accumulate in the beach areas. Subsequent wave action can carry the heavier particles further inland on the beach and pull finer particles further off-shore, where they can eventually move around the First Jetty to the east of the Seawall (FS, Page 1-18).

Summary of Site Exposure Risks to be Addressed in this EE/CA

The HHRA and SLERA focused on the impacted soils and sediments in close proximity to the Slag and battery casings as these Principal Sources had the highest concentrations of lead, arsenic, copper and antimony. In addition, the RI identified mechanical erosion of the Slag and battery casings as a primary contaminant transport mechanism to the soils and sediments that gives rise to the calculated risks in the HHRA and the SLERA. The goal of this EE/CA is to remove Principal Sources to eliminate human health risks, mitigate ecological risks and eliminate the potential for any further erosion, weathering or migration of the Principal Sources.

Human Health Risk Assessment

The HHRA conducted by USEPA dated December 13, 2011 determined that lead in soil, arsenic in fish and hard clams, and iron and cobalt in groundwater, create risks that exceed USEPA's thresholds. The HHRA further concluded, however, that the estimated risks to adults and children from consuming fish and clams caught within the Site area were very conservative (HHRA, Appendix T in the RI, page 6-5, 6-26). In addition, the HHRA noted that the risks from groundwater were derived from non-site sources, and also that groundwater at the Site is too saline to be potable and there are public sources of water available such that groundwater at the Site is neither consumed now nor likely to be consumed in the future (RI, page 6-4 and 7-11). This leaves lead in soil as the only plausible human health risk at the Site. This EE/CA is designed to address and eliminate this specific risk.



Ecological Risk Assessment

The USEPA's SLERA dated December 13, 2011 focused on Area 8 (Western Jetty) and Area 9 (Margaret's Creek) since the other areas did not have significant ecological receptors with the exception of Area 1 (area to the north of the Seawall). Area 1 was previously evaluated in a Biological Assessment Ecological Risk Assessment conducted by the USEPA Environmental Response Team (April 2010) (Biological Assessment). The SLERA and the Biological Assessment concluded that based on the maximum concentrations observed, both Site-related and non-site-related chemicals in Site media may pose a risk to ecological receptors in Areas 1, 8 and 9. Neither the SLERA nor the Biological Assessment considered the effects of background contribution to the identified risks or considered the average concentration over the exposure area for the species of concern. However, such factors are appropriate and should be considered in the remedy selection phase, and when these factors are taken into account, it clearly can be shown that risks to ecological receptors attributable to the Site are relatively low.

Removal Action Objectives

The removal action presented in this EE/CA is an interim action focused on removal of the Principal Sources located in Old Bridge and is designed to eliminate direct contact by both humans and ecological receptors with the Principal Sources, to eliminate mechanical erosion of the Principal Sources, to prevent continued migration of impacted materials and to reopen the beach and Seawall areas in Old Bridge in an expedited manner. The Alternatives described in this EE/CA are intended to address the highest concentrations of lead and other constituents of concern associated with the Slag as part of a comprehensive, phased response plan.

Removal Action Alternatives Considered

The actions considered in this EE/CA consist of no action, excavation of Principal Sources with on-Site containment, and excavation of Principal Sources with off-Site disposal. As there is



space available on-Site for containment of the total volume of the Principal Sources, this EE/CA does not examine an alternative that combines both on-Site containment and off-Site disposal. This is consistent with on-Site containment alternatives 5 and 6 examined in the FS, which first consolidate materials on-Site to the extent that space is available before including an off-Site disposal component.

Alternative 1 – No Action Alternative

The No Action Alternative was retained in accordance with the NCP requirement to serve as a baseline for comparison with the other alternatives. No additional actions would be performed. The current institutional controls (fencing and signs) would remain in place.

Alternative 2: On-Site Containment Alternative

The On-Site Containment Alternative consists of the excavation of the Principal Sources and on-Site containment. Two different options for on-Site containment are considered. The first option would involve containment in the upland area of the Site, with all Principal Sources placed in an engineered cell that is capped with a multi-layer geosynthetic and soil cover with the possible addition of a bottom cohesive soil (clay) barrier or liner. The second on-Site containment option, called Macroencapsulation, would involve relocation of the massive and heavy Slag to a position under and on the seaward side of the Park where it would be fully encapsulated after placement using a cementitious grout material. The encapsulated material would be capped on the top and fully covered on the front by a restored Seawall using clean rip-rap and similar heavy, dense material. The encapsulated material would serve as additional armor and protection to the Park and coast line in the area. Under this option, the other Principal Sources like the impacted soils and sediments, which generally have lower concentrations of contaminants of concern, would be contained in a smaller, engineered capped cell in the upland area of the Site.



Alternative 3: Off-Site Disposal Alternative

The Off-Site Disposal Alternative consists of the same excavation of the Principal Sources as described in Alternative 2 followed by treatment, transportation and disposal off-Site at designated third party disposal facilities.

Summary of Comparison of Alternatives

The alternatives have been evaluated for implementability, effectiveness, and cost. All of the alternatives are implementable as they utilize conventional technologies and construction techniques. However, Alternative 3, (Off-Site Disposal), would take at least two years to implement (and possibly much longer), more than twice as long to implement as Alternative 2 (On-Site Containment), thus significantly delaying reduction of risk and other goals like reopening of the beach to the public. In addition, Alternative 3 is less implementable than Alternative 2 when potential delays and the significant ongoing impacts to the community are considered. As presented more fully in Section 3.1.2.2 below, the Off-Site Disposal Alternative 3 would generate approximately 112,000 tons of impacted materials that must be trucked to off-Site disposal facilities and clean replacement materials trucked to the Site. This equates to approximately 9,290 fully loaded truck trips through the community, which will have a high likelihood of delaying the project as well as cause substantial detrimental impact on the local community (from traffic, exhaust emissions, dust, noise, etc.). It will take approximately 2.9 million miles to truck the materials to and return from the disposal location and bring in clean replacement soils. The truck traffic to transport materials to off-Site disposal facilities would use Route 35 in the vicinity of the Site, which already is among the roadways most prone to accidents in the entire state. With trucks more likely to be involved in vehicle accidents than cars, the thousands of additional trucks on the road would substantially increase the chances for a vehicle accident. The additional truck traffic certainly would significantly increase traffic congestion and associated delays, and would also increase noise, dust and exhaust emission pollution, all of which would detrimentally impact local residents and businesses.



In contrast, with the On-Site Containment Alternatives, most of the construction, trucking and material movement would be performed within the Site, which would be closed off to the public. This alternative would take about 6 to 12 months to implement and would require only trucks bringing equipment to the Site and clean replacement materials to travel through the community for an approximate total of just 2,450 fully loaded truck trips.

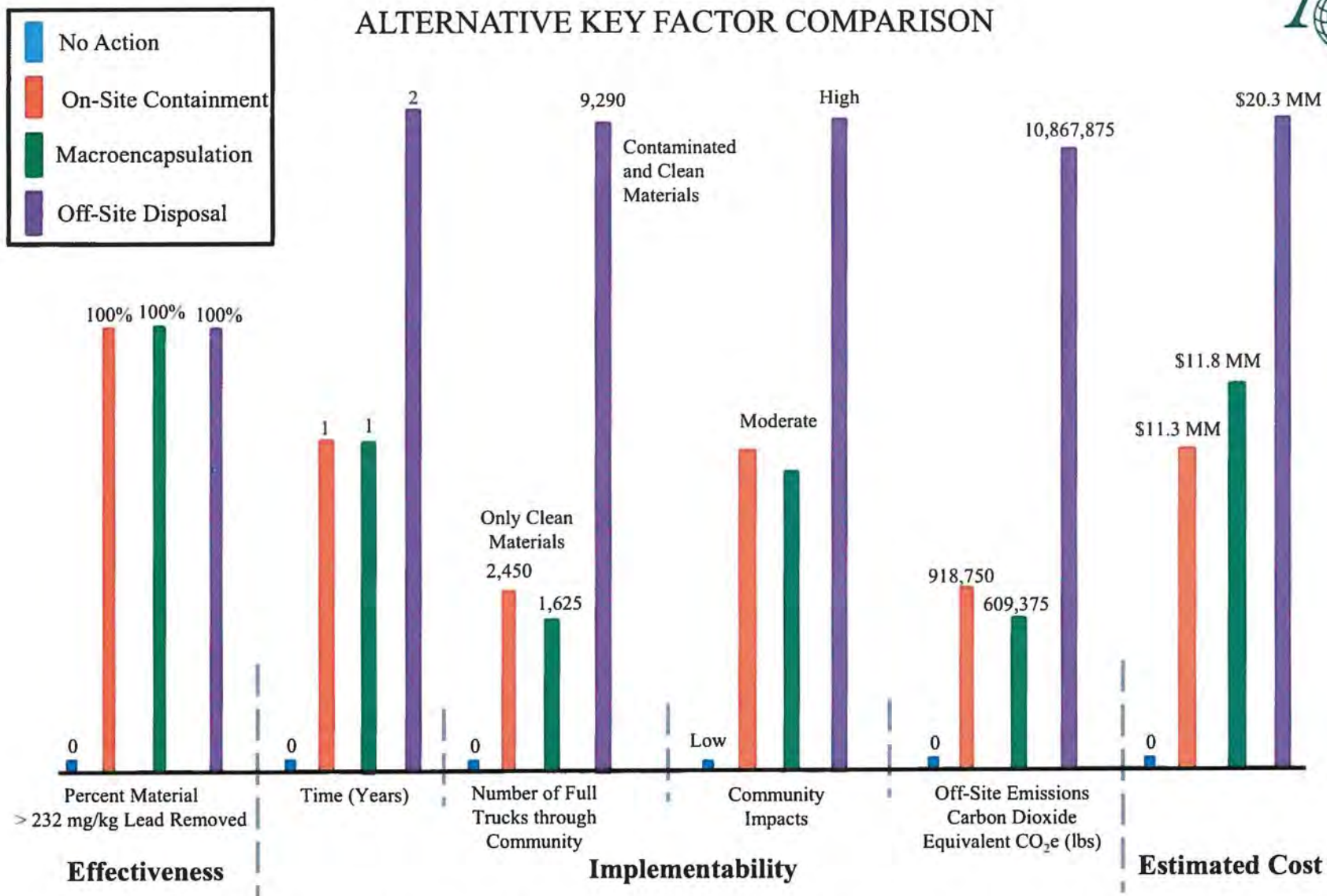
All of the alternatives, except for the No Action alternative are equally effective in the long-term in that they protect human health and the environment by eliminating direct contact with the Principal Sources. They also eliminate the potential for continued mechanical erosion of the Principal Sources and the potential for future impact on sediments and soils in the area. The On-Site Containment Alternative 2 options both require long-term maintenance of the caps. The Macroencapsulation option offers some improved long-term protection by encapsulating the Slag with cementitious material and takes advantage of the massive nature of the Slag pots to provide a secondary protection zone behind the restored Seawall made up of clean rip-rap to prevent shoreline erosion.

There is no significant cost associated with the No Action Alternative. The costs of the On-Site Containment options are similar at approximately \$11,275,000 (upland) and \$11,852,000 (Macroencapsulation and upland). The cost of Off-Site Disposal is almost double this cost at approximately \$20,281,000.

In summary, with the exception of the No Action alternative, all of the alternatives meet the removal action objectives. Alternatives 2A, 2B and 3 are equally effective in the long term. Both of the On-Site Containment options meet the project goals much more quickly and at half the cost, with less impact to the nearby communities and fewer truck trips along with the risk associated with transportation, less dust generated, and far fewer carbon emissions. A summary of the key factors which could be quantified is provided as Figure ES-1.



FIGURE ES-1
ALTERNATIVE KEY FACTOR COMPARISON



Community impacts include noise, dust, traffic congestion, traffic accidents and exhaust emissions.

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1.0 SITE CHARACTERIZATION

The Site, located as shown on Figure 1-1, is currently listed on the NPL and is subject to the requirements of CERCLA. The EE/CA has been prepared in response to a request by the USEPA to address the Principal Sources located within Old Bridge. These Principal Sources consist of Slag and battery casings located in the seawall and adjacent Slag-impacted soils and sediments. The location of the Principal Sources to be addressed by this EE/CA is shown on Figure 1-2.

USEPA has completed the RI, HHRA, SLERA and FS for the Site and is currently in the process of developing a Proposed Plan for the Site. Under any remedial alternative ultimately selected by USEPA, the Principal Sources of lead in the Old Bridge area of the Site will need to be removed. These Principal Sources drive all human health risk and the majority of ecological risks calculated in the HHRA and SLERA, respectively, at the Site and, for this reason, removal of these Principal Sources as an initial action at the Site will address and eliminate a majority of the risk at the Site. NL has prepared this EE/CA as an interim measure designed to address those Principal Sources of lead located in Old Bridge, where removal will have the greatest impact in reducing risks at the Site. The EE/CA is based upon the information gathered by USEPA's investigations and reported in the RI, HHRA and SLERA, and is consistent with the proposed remedial alternatives identified by the USEPA in the FS.

In accordance with the guidance on time critical removal actions under CERCLA, this section summarizes available data that characterizes the Site and surrounding areas, including current and historical information. A Site description and background discussion, a summary of previous investigations, identification of sources and the nature and extent of contamination, as well as a streamlined risk evaluation are provided. Each of these subsections is discussed in the following text.



1.1 SITE DESCRIPTION AND BACKGROUND

The Site is located on the shore of Raritan Bay, in the eastern part of Old Bridge within the Laurence Harbor section of Middlesex County, New Jersey. Raritan Bay is also referred to as Raritan-Sandy Hook Bay, but “Raritan Bay” will be used throughout this document. A small portion of the western end of the Site, the Western Jetty at the Cheesequake Creek Inlet, is located in Sayreville. The Site is bordered to the north by Raritan Bay and to the east, west, and south by residential properties. State Highway 35 is located to the south beyond the residential properties.

The Site consists of an approximately 2,500 feet long Seawall that is partially constructed of Slag and broken battery casings, beach areas, an upland area to the east of the Seawall where Slag and battery casings had been deposited, the Western Jetty at the Cheesequake Creek Inlet where Slag was also placed and soils and sediments that have been impacted by the weathering and erosion of the Slag. Figure 1-2 shows the areas of the Site addressed by this EE/CA.

1.2 SITE HISTORY

The Site is approximately 1.5 miles in length. The Seawall and beach portions of the Site are part of the Old Bridge Waterfront Park (Park). The Park includes walking paths, a playground area, several public beaches, and three jetties. The Park is protected by the Seawall, which is partially constructed with Slag. The Margaret’s Creek area contains approximately 47 acres of wetlands that are vegetated and partially flooded and approximately 24.5 acres of dry upland area that is dominated by scrub vegetation. The Site also consists of the Western Jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty located in Sayreville, which are not covered by this EE/CA.

The RI and FS divide the Site into 11 Areas as shown on Figure 1-1. This EE/CA addresses Areas 1, 2, 4, 5 and portions of Area 9 located in Old Bridge as shown on Figure 1-2. Additional information about the history of the other areas of the Site can be found in the RI and FS.



The Slag was reportedly deposited at the beachfront in the late 1960s and early 1970s as part of a federal and local government approved shore protection project. The Slag was largely in the form of “pots,” each weighing about 450 pounds (which are dense, solid and not degradable), to armor an area that had sustained significant beach erosion and damage due to a series of storms in the 1960s. The Slag contains approximately 6% to 8% lead, 2% antimony, 1% copper and 0.5% arsenic. Non-lead impacted demolition debris in the form of concrete and a variety of bricks, including fire bricks, was also found along with the Slag in the Seawall. A portion of the Seawall in Old Bridge also contains large, non-contaminated rip-rap believed to have been placed over the Slag when the grassed and paved portion of the Park was developed.

Elevated levels of lead, antimony, arsenic and copper were identified by the NJDEP in the soil along the Seawall in 2007 and at the edge of the beach near the western end of the Seawall. Old Bridge placed a temporary “snow” fence in this area, posted “Keep-Off” signs in the park along the split rail fence that borders the edge of the Seawall, and notified the residents of Laurence Harbor.

On April 24, 2008, USEPA’s Removal Action Branch received a request from NJDEP to evaluate the Laurence Harbor Seawall for a removal action under the CERCLA. The CERCLA Information System Identification number for the Site is NJN000206276. On November 3, 2008, NJDEP forwarded an amended request to include the Western Jetty along the Cheesequake Creek Inlet to the overall Site.

USEPA collected samples at the Site in September 2008 as part of an Integrated Assessment. The purpose of this sampling event was to determine whether further action under the CERCLA was needed. The sampling included the collection of soil, sediment, water, biological, and Slag samples. USEPA and NJDEP analytical results indicated that significantly elevated levels of lead and other heavy metals are present in the Slag, soils and sediments.



At USEPA's request, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), evaluated the analytical data from the samples collected at the Site. Their findings concluded that, due to the elevated lead levels, a Public Health Hazard exists at the Seawall in Laurence Harbor, the beach between the western end of the Seawall and the First Jetty, and the Western Jetty at the Cheesequake Creek Inlet, including the waterfront area immediately west of the inlet (ATSDR, 2009). As a result of this determination, USEPA restricted access to these areas by installing permanent fences and posting signs and provided public outreach to inform residents and visitors to those areas that a health hazard exists.

In March 2009, the property associated with Margaret's Creek was also included in the overall Site through a request made to the Remedial Program. The Site was listed on the NPL on November 2, 2009.

USEPA conducted the RI at the Site from September 2010 to June 2011. The RI, including the HHRA and the SLERA (dated December 13, 2011), was issued on December 22, 2011. The FS was issued on February 29, 2012. Information from those reports forms the basis of this EE/CA. The RI, FS, HHRA and SLERA are available in the public repository in Old Bridge and from USEPA.

1.3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The Site topography is characterized by a gradual rise along the beach to shore bluffs. The bluffs extend the length of the Site along the Bay except for Area 9, in front of the Margaret's Creek wetlands. The elevation at the top of the shore bluffs is about 30 feet above MSL. South of the bluffs, the terrain is primarily flat.

The Raritan Bay bathymetry near the beach in Area 2 is characterized by a very gradual seaward slope. A significant ebb shoal (shallow depositional area) has built up near the mouth of Cheesequake Creek (Area 7). North of this ebb shoal, the depth increases sharply.



Surface water drainage in the vicinity of the Site is toward the tidal creeks and their associated wetlands. The major surface water bodies at the Site include Raritan Bay, Cheesequake Creek, and Margaret's Creek. These water bodies are subject to daily tidal fluctuations averaging 5.5 feet. Because the slope of the Raritan Bay floor is very gentle, 400 to 600 feet of the bay floor are exposed during low spring tide. The Site, except for the majority of the Park and portions of the upland areas in Margaret's Creek, is located within the 100-year flood plain.

1.3.1 Geology

The Site is located in the Coastal Plain Physiographic Province of New Jersey, a seaward-sloping wedge of unconsolidated sediments ranging in age from Cretaceous to Holocene. The coastal plain sediments are composed of clay, sand, silt, and gravel, and are overlain by Quaternary age deposits. In the vicinity of the Site, the Quaternary deposits are underlain by the Upper Cretaceous age Magothy and Raritan Formations which are, in turn, underlain by the Lower Cretaceous age Potomac Group.

1.3.2 Hydrogeology

The major aquifer system in this region is the New Jersey Coast Plain Aquifer System. The aquifer system at the Site is composed of the Potomac-Raritan-Magothy Formations (PRM). Synoptic and continuous water level data from the monitoring wells indicate that much of the Site area groundwater is affected by tides. Wells closest to the bay and near the Cheesequake Creek Inlet show the greatest fluctuations in water elevations between high and low tides. Site wells exhibit a horizontal gradient toward the bay. Groundwater at the Site is classified as Class II by the NJDEP. However, the groundwater in the Site vicinity has high salinity due to impacts from the bay water.

At the western end of the Seawall, under low tide conditions, groundwater flow is toward the bay. Under high tide conditions, the overall groundwater flow direction is also toward the bay, but flow is more complex due to the influence of tides and the vertical gradient. The eastern end



of the Seawall at low and high tide shows a simpler groundwater flow system. Lateral groundwater flow at low tide is toward the bay while at high tide lateral groundwater flow is inland.

1.4 REMEDIAL INVESTIGATION AND INVESTIGATION AREAS

For purposes of the RI and FS, the Site was divided into 11 Site areas based on historical investigations, Site physical characteristics, and the locations of known or potential sources. Figure 1-2 shows the Site investigation areas considered in this EE/CA. For the purposes of this EE/CA, the Site is limited to Areas 1, 2, 4, 5 and portions of Area 9 defined as follows:

- Area 1: Laurence Harbor Seawall (Seawall) - The seawall along and in front of the Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Laurence Parkway.
- Area 2: Laurence Harbor Beach (Area 2 Beach) - The beach area at the foot of Laurence Parkway between the western end of the Seawall and the First Jetty and the intertidal sediments to the north of the beach.
- Area 4: Old Bridge Waterfront Park (Park) - The park area along the Seawall (not including the playground) from the fence to the roadway.
- Area 5: Laurence Harbor Beach (Area 5 Beach) - The beach area between the First and Third Jetty.
- Area 9: Margaret's Creek (Upland) - The wetlands and upland areas associated with the Creek between the beach and Route 35.



USEPA conducted extensive sampling of all Site areas in the RI, including characterization of the source materials (Slag and battery casing material), soils, wetlands and intertidal sediments, surface water, groundwater and biota. To facilitate evaluation of the results, the RI discussions were organized into three sectors based on the type of environment and proximity to source areas; the three sectors include the Seawall Sector (Areas 1, 2, 3, 4, 5, and 6), the Jetty Sector (Areas 7, 8, and 11), and Margaret's Creek Sector (Area 9). Background areas for sediments and wetlands which were unaffected by Site conditions, including Slag and battery casings, were also evaluated (Whale Creek Wetlands and a portion of Raritan Bay Beach (Area 10) as shown on Figure 1-1). The results of these investigations can be reviewed in the RI; pertinent aspects of the RI as they relate to this EE/CA are summarized in the following sections.

1.5 POTENTIAL SOURCES, NATURE AND EXTENT OF CONTAMINATION

1.5.1 Principal Source Material Characteristics

In the Seawall sector, the primary sources of Site-related metals contamination are Slag and battery casings. The Seawall is up to 80% Slag. Battery casings were found in the upper 2 inches of depositional zones in Areas 2 and 5. Buried Slag was observed in 7 of 26 test excavations on the upland side of the Seawall in Area 1 and the eastern end of Area 4 to depths ranging from 1 to 5 feet below the ground surface (BGS). Soil and sediments impacted by the Slag at the Seawall are documented in the RI with the highest concentrations of Slag-related constituents in Area 1 sediments directly to the north of the Seawall.

Small amounts of battery casings and Slag are located in the Margaret's Creek Uplands area (Area 9).

The metals lead, arsenic, copper, antimony, and chromium were identified as Site-related metals in the RI. These metals were found to be associated with the Slag source material, were detected in Site media at elevated concentrations, and were expected to contribute most significantly to potential risk in the media evaluated at the Site.



The RI concluded that Site-related soil and sediment contamination in the Seawall sector is defined by co-located lead and arsenic contamination in specific depositional areas (Areas 2 and 5) and areas associated with Slag (Seawall and Upland), (RI, page 7-3). However, both lead and arsenic are naturally present in the environment and have anthropogenic sources other than the Principal Sources as indicated by the concentrations of lead and arsenic identified in USEPA's background Area 10, Whale Creek. The Whale Creek background area includes wetlands and is located to the east of the Site study area in a location that is unaffected by the Principal Sources at the Site. Arsenic concentrations in the Whale Creek wetlands sediments ranged from 13.6 mg/kg up to 49.5 mg/kg and the lead concentrations ranged 71.6 to 193 mg/kg. (HHRA, Appendix T in the RI, page 6-15)

1.5.2 Migration of Contaminants from the Source Materials

The primary migration pathway from the Slag and battery casing materials to other areas of the Site is long-term, slow mechanical erosion from rain and wave action. Thus, elimination of this migration pathway is a primary objective of the removal action proposed in this EE/CA. Solid particles may over time break off from the source material, and rain and wave action carry the particles into the sediment directly in front of the Seawall. Continued wave action suspends the particles into the water column where they can then be carried further to the west by the long-shore current. The jetties intersect the long-shore current and cause the particles to drop out of the water column and be deposited into accretion areas on the eastern side of the jetties. Heavier particles (sand-sized) accumulate in the beach area and are carried further inland by subsequent wave action. During storms, additional erosion and movement of Slag-related sediments, particularly the finer particles, may occur, carrying particles around the First Jetty where they can move further to the west. By this model, mechanical erosion of the Slag in the Seawall and subsequent movement of eroded particles by waves and currents is the primary cause of Slag-impacted soils and sediments in front of the Seawall, to the west in the beach and intertidal area and between the First and Second Jetties (FS, Page 1-18). The discharge of streams and creeks, such as Margaret's Creek, into the bay also impact currents and sediment deposition as discussed in the RI.



1.5.3 Identification of Excavation Area Boundaries

The goal of this EE/CA is to excavate, and either contain on-Site or dispose off-Site, the Principal Sources to prevent further mechanical erosion and to eliminate any direct access and exposure to those materials by human or ecological receptors. To determine the boundaries of the excavation areas, several lines of evidence were used, many of which were presented in the RI and FS. Those lines of evidence include: 1) data showing the areas containing Slag and battery casings, 2) data showing the locations of soils and sediments next to, under or near the Slag and casings with measured concentrations of lead exceeding 232 mg/kg, the Preliminary Remediation Goal established in the FS for lead (Lead PRG), 3) data concerning the migration pathways of material eroded from the Slag and casings, 4) information concerning areas with the greatest access by the public, 5) information concerning the physical capabilities and reach of conventional construction equipment positioned on-shore in the area of the Seawall, Area 2 and Area 5 Beaches, and 6) EPA guidance including the *Lead-Contaminated Residential Sites Handbook* (USEPA, 2003) and *Presumptive Remedy for Metals-in-Soil Sites* (USEPA, 1999).

Figure 1-2 shows the horizontal boundaries of the proposed excavation areas, which capture the Slag and battery casings in Areas 1, 2, 5 and 9. Because the long-shore current moves the sediments westward from the Seawall (Area 1) into accumulation areas by the First Jetty (Area 2) with some contamination being carried to the west past the First Jetty (Area 5), sediments and beach soils in Areas 1, 2 and Area 5 are included in the excavation boundary.

1.5.3.1 **Soils/Sands**

In the Area 2 Beach, based on the RI sampling results, soils exceeding the Lead PRG will be excavated to a total depth of 4 feet. In the Area 5 Beach, based on the RI sampling results, soils will be excavated to a depth of 1 foot, which addresses all soils exceeding the Lead PRG. In the Seawall area, excavation will include all visible Slag and battery casings, plus an additional one foot of soils beneath the Slag and casings and extending to a depth of 1 foot up to 25 feet behind



(landward of) the Seawall. The Seawall removal area will be restored with 1 foot of clean sands/soil and then topped with a new Seawall made from non-lead impacted rip-rap and other heavy materials. It is expected that the soils remaining 1 foot below the bottom of the Slag and battery casings will have lead concentrations less than 232 mg/kg. In the event that a minor amount of soils with lead concentrations remain above 232 mg/kg, the replacement soils and clean rip-rap will prohibit any contact with such soils by either human or ecological receptors. In the Upland area, all visible Slag and battery casings will be removed plus an additional 1 foot below those areas and extending horizontally 10 feet on each side of the excavation area. The excavated soils will be replaced with clean fill.

1.5.3.2 Sediments

Excavation of sediments will take place along the entire length of the Seawall and Areas 2 and 5 Beaches (approximately 3,300 lineal feet). The general horizontal boundary for removal of off-shore sediments from these areas has been established based on RI data to capture sediments that exceed the Lead PRG. Much of this area can be excavated using a conventional long-arm excavator with a 50-foot reach, but crane mats will be required in Areas 2 and 5 to capture RI data points beyond 50 feet from shore. The vertical boundary for removal of off-shore sediments from these Areas has been established based on RI data to capture sediments exceeding the Lead PRG. Generally, the depth of excavation is 1 foot, except in 3 limited areas where excavation will extend to 2 feet to capture RI data points exceeding the Lead PRG.

With this approach to removal of soils and sediments, human health risks associated with lead will be removed leaving no plausible human health risks associated with the Old Bridge portion of the Site. In addition, since this approach removes the sediments with lead concentrations above 232 mg/kg on a point by point basis to the full depth of contamination as identified in the RI, there will be no ecological risk related to lead remaining in Areas 1, 2 and 5.



Ecological risks associated with arsenic and other site-related contaminants are also eliminated along with the removal based on lead. The ecologically based PRG derived in the FS for sediment is 26 mg/kg of arsenic based on the mink which has a foraging area of 1,900 acres. After the removal for lead is performed, only two samples remain with arsenic concentrations above 26 mg/kg with concentrations of 32.6 and 38.1 mg/kg. Since mink forage was a driver for the arsenic cleanup goal, mink foraging along the shoreline and sediment within at least 50 feet of the shoreline will be removed and replaced with clean materials. This will reduce the average concentration of arsenic over the mink's foraging areas which will be below the ecologically based PRGs after the actions proposed in this EE/CA are performed. For copper, no sample results above the ecologically based PRG of 206 mg/kg remain.

1.6 STREAMLINED RISK EVALUATION

As part of the RI, USEPA conducted a HHRA and a SLERA for both Site-related and non-site-related contaminants of concern. Those documents are attached as Exhibits T and U, respectively, to the RI report and are discussed in the RI and FS.

1.6.1 Human Health Risk Assessment

The HHRA conducted by USEPA dated December 13, 2011 determined that lead in soil, arsenic in fish and hard clams, and iron and cobalt in groundwater, create human health risks that exceed USEPA's thresholds. The HHRA further concluded, however, that the estimated risks to adults and children from consuming fish and clams caught within the Site area were very conservative (HHRA, Appendix T in the RI, page 6-5, 6-26). In addition, the HHRA noted that the risks from groundwater were derived from non-Site sources, and also that groundwater at the Site is too saline to be potable and there are public sources of water available such that groundwater at the Site is neither consumed now nor likely to be consumed in the future (RI, page 6-4 and 7-11). This leaves lead in soil as the only plausible human health risk at the Site. This EE/CA is designed to address and eliminate this specific risk.



1.6.2 Ecological Risk Assessment

The USEPA's SLERA dated December 13, 2011 focused on Areas 8 (Western Jetty) and Area 9 (Margaret's Creek) since the other areas did not have significant ecological receptors with the exception of Area 1 (area to the north of the Seawall). Area 1 was previously evaluated in a Biological Assessment Ecological Risk Assessment conducted by the USEPA Environmental Response Team (April 2010) (Biological Assessment). The SLERA and the Biological Assessment concluded that based on the maximum concentrations observed, both Site-related and non-Site-related chemicals in Site media may pose a risk to ecological receptors in Areas 1, 8 and 9. As per USEPA guidance, neither the SLERA nor the Biological Assessment considered the effects of background contribution to the identified risks or considered the average concentration over the exposure area for the species of concern. Such factors are appropriate for consideration in the remedy selection phase, and when taken into account it can be shown that risks to ecological receptors at the Site are relatively low.

This EE/CA is designed to address the Principal Sources in the public areas of the Site, where there is the greatest likelihood of exposure, so as to eliminate any risk to human health. The removal of Principal Source materials will also significantly reduce ecological risk by preventing direct contact of ecological receptors with Principal Source materials and avoiding potential release and migration of contaminants from mechanical erosion of the Slag.



2.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The objectives of this removal/response action are identified in this section. The statutory limits, the scope of the removal/response action, the schedule, and the planned response activities are discussed. Each of these components is addressed in the remainder of this section.

2.1 STATUTORY LIMITS ON REMOVAL ACTIONS

Financial restrictions and time limits do not apply to non-federal lead removal actions.

2.2 DETERMINATION OF REMOVAL SCOPE AND REMOVAL ACTION OBJECTIVES (RAOs)

The following RAOs have been established for this EE/CA:

- To complete a removal action of Principal Sources that is implementable and an effective component of the final remedy for the Site to the extent practicable;
- To eliminate the potential for contact of recreational users, residents, visitors, workers, anglers and ecological receptors to the Principal Sources in the Old Bridge sectors of the Site and reopen the public areas as quickly as possible;
- To eliminate the potential for humans and ecological receptors to contact soils and sediments with lead concentrations exceeding the Lead PRG; and
- To eliminate the potential for release of constituents from the Principal Source materials via mechanical weathering to soils, sediments or surface water migration pathways.



2.2.1 Volumes of Materials To Be Addressed in Removal Action

Slag and battery casing surveys conducted by USEPA at the Seawall and the Upland sectors presented in the FS established Slag and/or battery casing distribution with a volume of approximately 6,100 CY. Since the Slag and battery casing surveys did not extend through the entire depth of the Seawall, the volume of source materials in the Seawall was assumed to be 15,000 CY which yields an average depth of about 5.5 feet along the 2,500 lineal feet of Seawall. The estimated volume of soil/sediment to be excavated in the areas shown on Figure 1-2 is approximately 27,600 CY. Table 2-1 provides a listing of the volumes and estimated tonnage to be excavated as part of the removal action.

2.3 DETERMINATION OF REMOVAL SCHEDULE

Construction of the selected alternative can be completed within 6 to 12 months of the start of construction activities for Alternative 2 On-Site Containment (Alternatives 2A and 2B), or a minimum of 24 months for Alternative 3 Off-site Disposal.

2.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The FS provided a listing of the possible ARARs identified for the project, which is provided in Appendix A to this EE/CA.

2.5 PLANNED REMOVAL ACTIVITIES

The alternatives considered in this EE/CA are a combination of excavation of the Principal Sources followed by either on-site containment or off-site disposal. The No Action alternative is also presented for comparison purposes.



2.6 PRE-DESIGN INVESTIGATION

The Pre-Design Investigation is proposed in order to complete the detailed removal action design. The Pre-Design Investigation will consist of the following tasks:

- Test pit/test boring studies in the Seawall and Upland areas to confirm actual depths of Slag and battery casings and to investigate the soil characteristics below the source materials as part of assessing migration of lead and arsenic via leaching;
- Leaching studies using intact pieces of Slag and Slag-impacted soil/sediment and Site groundwater to assist in determining whether a bottom liner is required for on-Site containment;
- Surface water sampling from the Raritan Bay to understand potential total and dissolved lead concentrations;
- Groundwater sampling of three Site monitoring wells (MW-10S, MW-10D, and MW-12S) and the background monitoring well (MW-11S) to understand potential total and dissolved lead concentrations for leaching determination;
- (For Alternative 2) Geotechnical study of the subsoils and natural clay located in the Upland area to determine the soil characteristics with respect to contaminant migration and suitability for use as structural fill and/or possibly a liner for the Upland containment cell; and
- Visual observation of RI data points in the Upland area to confirm if they are the result of Slag/battery casings or some unrelated source.



3.0 REMOVAL ACTION ALTERNATIVES

The scope of the response/removal action has been developed based on review of the USEPA's RI and FS documents.

3.1 REMOVAL ALTERNATIVES

The following alternatives have been developed for evaluation and to determine the best course of action to meet the project RAOs. A brief description of the three proposed alternatives is provided below.

- **Alternative 1: No Action** - No additional actions would be performed. The current institutional controls (fencing and signs) would remain in place.
- **Alternative 2: On-Site Containment** - This alternative utilizes excavation of the Principal Sources and containment of these materials using one of two optional containment approaches:
 - **Alternative 2A: Upland Containment Cell** - This alternative contains the Principal Sources in the area located in the Upland sector shown on Figure 3-1. EPA's conceptual rendering of an Upland Containment Cell is included as Figure 3-2. The engineered containment area would consist of an excavated cell, side berms constructed from the excavated soils and a geosynthetic and soil impermeable cap. During the Pre-Design Investigation, additional studies would be performed to determine an effective design to prevent infiltration of the cell by rainwater, surface water, groundwater and stormwater and thus eliminate the generation of any leachate. If the design studies confirm that migration of lead from the bottom or sides of the cell is possible or that lead-contaminated leachate may collect in the cell and migrate out of the cell, the existing underlying



natural clay available in the Upland sector would be studied to determine if it provides a low permeability bottom and possible side barriers to the cell and would be compared to traditional geosynthetic liners and leachate collection systems to determine effectiveness.

- **Alternative 2B: Source Material Macroencapsulation and Permeable Upland Cap (Macroencapsulation)** - This alternative utilizes excavation and treatment of the Slag and highest concentration Principal Source materials with a Macroencapsulation solidification treatment. This material would be moved up and out of the water to an area behind the existing Seawall in the bayside of the Park, and encapsulated and capped as shown in Figure 3-3. A new Seawall would be constructed directly in front of the encapsulated material. Impacted soils/sediments which have lower lead and arsenic concentrations and, in many cases, only marginally exceed human health and ecological standards, will be placed under an engineered, permeable cap in the Upland sector also shown on Figure 3-3.
- **Alternative 3: Off-Site Disposal** - This alternative utilizes excavation and on-Site or off-Site treatment of Principal Sources and trucking to and disposal of all materials at designated off-Site third-party disposal facilities.

These alternatives are analyzed below for their effectiveness, implementability, and cost. Effectiveness is evaluated in terms of protectiveness and ability to achieve the RAOs stated in Section 2.2. The effectiveness of the alternatives is assessed in terms of how well they protect public health and the community in the short and long term, protect workers during implementation, protect the environment in the short and long term, and comply with ARARs. The implementability of the alternatives depends on their technical feasibility, the availability of necessary resources to support the alternatives, their administrative feasibility, community impact, duration and cost. For this analysis, technical feasibility, availability of necessary resources and administrative feasibility are assumed to be the same for all alternatives.



3.1.1 Alternative 1: No Action

Description

This alternative provides a baseline for comparison with other alternatives and is required by CERCLA to be evaluated. Access to the impacted areas would be restricted by existing fencing and community awareness preventing recreational users to access the Seawall, beach areas, and intertidal sediment areas until further sampling, monitoring and evaluation have been completed. The Slag source materials would continue to be subject to mechanical erosion and may migrate into the soil and sediments. No additional institutional controls would be performed under this alternative.

Implementability

This alternative is implementable. Long-term maintenance and community awareness can continue to be implemented and direct contact exposure risks to humans will continue to be prevented through existing fencing and warning signs. As there is no truck traffic associated with this alternative, there is no increase in off-Site emissions of carbon dioxide equivalents.

Effectiveness

Since this alternative does not involve any changes to existing conditions, the implementation of this alternative does not result in any additional risks to the community or the environment.

This alternative prevents access and exposure by recreational users and the local community to recreational areas, the beaches and intertidal areas. This alternative does not reduce exposure to ecological receptors and does not mitigate the potential for further erosion and migration of the Principal Sources.



Cost

There would be minimal cost to maintain the fencing and signs for this alternative.

3.1.2 Alternative 2: On-Site Containment

3.1.2.1 Alternative 2A Upland Containment

Description

To address the RAOs stated in Section 2, this alternative consists of the following elements:

- 1) Excavation of the Principal Sources as described in Section 1.5.3 above and shown on Figure 1-2 using conventional excavation equipment large enough to remove the Slag pots and large rip-rap. The material would be staged and segregated to retain the clean rip-rap for restoration of the Seawall.
- 2) The Principal Sources would be loaded onto off-road trucks and transported within the Site boundaries for placement within the containment cell. The proposed location of the containment cell is within the Upland sector in the location shown on Figure 3-1 and as rendered by EPA in an example of a final cell in Figure 3-2. This location is outside of the 100-year flood plain and is readily accessed by Route 35 for import of capping materials.

In order to transport waste materials to the containment cell and avoid using public roadways, a temporary haul road would be installed on the existing pathway as shown on Figure 3-1. The pathway would be upgraded to withstand the haul trucks. Additionally, as the route crosses Margaret's Creek, a temporary bridge would be erected to allow off-road trucks to transport excavated materials to the Upland containment cell.



The Upland containment cell would be constructed by excavating native soils to a depth of about 7 to 8 feet below the ground surface and installing an earthen berm using the excavated soils to create sidewalls to contain the Principal Source materials. Excess excavated soils would be retained for use as cap cover soils and/or to replace excavated Principal Source materials. The footprint of the cell is anticipated to be approximately five (5) to six (6) acres (Figure 3-1). Excavated Principal Source materials would be dewatered as necessary and placed in lifts and compacted. Following completion of excavation and placement activities, the Principal Sources would be capped using a multi-layer geosynthetic and soil cap as shown on Figure 3-4. It is estimated that a total volume of almost 100,000 CY could be placed in the Upland containment area, sufficient to contain more than twice as much as the entire estimated volume of materials to be excavated (43,400 CY) under this EE/CA. The multi-layer geosynthetic cap would consist of a geotextile or sand layer, geomembrane and geocomposite drainage layer (Figure 3-4). Following the geosynthetic installation, two (2) feet of protective soils (cap cover and topsoil) would be placed over the cap to protect the geosynthetics and promote vegetation establishment.

Additionally, there is a clay soil layer over 15 feet thick located beneath the proposed Upland containment area, which may provide a natural buffer to adsorb any lead or arsenic potentially mobilized from the Principal Sources contained in the cell. This clay layer is described in boring MW-15S and pictures of the clay during excavation of the interceptor pipe are also provided in Appendix B. These natural characteristics of the proposed Upland containment area, combined with the characteristics of the Principal Sources in being dense, inert and non-degradable, make this area a suitable location for a containment cell. This clay layer will be further investigated in the Pre-Design Investigation.

During the Pre-Design Investigation, additional studies would be performed to design the cell so that no lead contaminated leachate may collect in the cell or migrate to groundwater or surface water from the sides or the bottom of the cell during flooding or storm events. If the design studies confirm that migration from the bottom or sides of the cell is possible or that lead contaminated leachate may collect in the cell and migrate out of the cell, the natural clay



available in the Upland sector would be studied to determine if it can be used or constructed to provide a non-permeable bottom and possible side barriers to the cell and would be compared to traditional geosynthetic liners and leachate collection systems to determine effectiveness.

Following completion of the excavation and placement activities, reconstruction of the Seawall would consist of placement of geotextile followed by clean rip-rap over the underlying soils. Imported rip-rap would be placed as needed to provide protection. Near-shore intertidal sediments would be replaced with similar, imported fill material to pre-construction grades. It is anticipated that in order to excavate the Seawall, the existing Park would be disturbed. Following removal activities, the Park would be restored to existing conditions.

Implementability

Excavation of Principal Sources: This component of the remedy is considered readily implementable and may be accomplished by traditional excavating methods. Construction equipment (e.g., mid-size and extended reach excavators and off-road haul trucks) for soils is readily available and can be mobilized to the Site. Specific equipment such as large excavators for rip-rap and Slag segregation as well as long stick excavators and crane mats for sediment removal are more specialty items, but are available in the surrounding areas. Bridge construction over Margaret's Creek can be accomplished with conventional temporary bridging components.

This alternative minimizes impact to the surrounding community. The majority of the work would be conducted within the Site boundaries, and thus access to and through the nearby community would be minimized. No hazardous materials would need to be exported as part of this alternative, as shown in Table 3-1, meaning that no hazardous material would be transported through the community. Only trucks bringing in equipment and clean replacement materials would need to travel on public roads, minimizing the potential for delay of the project and impact to traffic, noise, truck emissions and wear and tear on local roads. Access to all construction areas would be restricted by fencing and subject to a community awareness program during the duration of the project. Table 3-1 shows that implementation of this alternative would



involve substantially fewer truck trips (estimated to be approximately 2,450 truck trips in total) than the Off-site Disposal Alternative. Following the procedures laid out in EPA's guidance document, *Methodology for Understanding and Reducing a Project's Environmental Footprint* (EPA 542-R-12-002, February 2012), the estimated emissions associated with off-Site transportation for this alternative are 918,750 pounds (lbs) of carbon dioxide equivalents.

Upland containment cell construction: Structural fill, cap cover soil, topsoil and the geosynthetics are available for cell construction. The proposed footprint of the Upland containment cell would allow all of the estimated excavated Principal Source materials to be placed and capped within the proposed footprint. The actual dimensions and final elevations of the containment cell would be determined during the design process and the cell would be designed to not to allow rainwater, surface water, flood water or groundwater to infiltrate and make contact with the materials or migrate out of the cell. The cell would be designed to appropriately manage stormwater flow so as not to damage the cap or negatively impact the nearby community or the wetlands located adjacent to the Upland area.

Upland containment cell maintenance: Maintenance of this kind of containment cell is conventional and would generally consist of periodic monitoring to ensure the integrity of the cap and the implementation of any necessary repairs like replacement of small areas of eroded soils and vegetation. If leachate collection and disposal is ultimately necessary, such maintenance is also conventional.

Restoration: The disturbed areas of the Site would be restored to existing conditions following removal activities. All restoration is readily implementable including in the Park, beaches and intertidal areas that are used for public recreation. The Upland containment cell area would also be restored to a vegetative state to prevent erosion and exposure to impacted materials.

Project Duration: The duration of this project is estimated to be 6 to 12 months from mobilization to the Site.



This remedy can be constructed in accordance with all ARARs. A list of potentially applicable ARARs from the FS is provided as Appendix A to this EE/CA.

Effectiveness

Excavation of the Principal Sources would permanently remove all direct contact with those materials by humans and ecological receptors. In addition, the Principal Sources would no longer be subject to erosion and migration. The Upland containment cell would be designed and maintained to prevent any future direct contact with materials or migration of these materials outside of the containment cell. Consequently, there would be no residual risk associated with the Principal Sources under this alternative.

Although there is a potential for cross-contamination and dust issues in the short-term during construction activities, the impacts would be mitigated by implementing erosion controls and dust suppression as well as air monitoring during earth disturbance activities. These potential impacts are mitigated further under this alternative because all work with contaminated material will be performed inside the restricted areas of the Site.

The Principal Sources would no longer be exposed to surface water. The existing groundwater data shows that even with the lead source materials completely exposed to the environment, no significant releases to groundwater are occurring at this time. Capping the materials would eliminate the potential for impacts to groundwater, surface water and the environment.

The final controls (i.e., excavation, containment and maintenance of the cell) described under this alternative are demonstrated, conventional and proven technologies based on traditional civil and environmental procedures and construction techniques. Such techniques and procedures are reliable and would adequately meet the intended project RAOs. Similar on-site capping/containment remedies have been successfully implemented at numerous sites across the United States, including the Jack's Creek Superfund Site and Marjol Battery RCRA Site to address similar lead materials on-site.



Cost

The estimated capital cost of this alternative is \$11,275,000. Table 3-2 provides a summary of the costs anticipated for this alternative. The cost estimate does not include costs for a cell liner, the need for which would be determined during the design phase.

3.1.2.2 Alternative 2B: Macroencapsulation and Permeable Upland Cap

To address the RAOs stated in Section 2, this alternative consists of the following elements:

- 1) Excavation of the Principal Sources as described in Section 1.5.3 above and shown on Figure 1-2 using conventional excavation equipment large enough to remove the Slag and large rip-rap. The material would be staged and segregated to retain the clean rip-rap for restoration of the Seawall.
- 2) The Slag would be consolidated and moved to a location out of the water and behind the existing Seawall where it would be encapsulated using a cementitious grout. Two possible locations for the encapsulation area are shown on Figure 3-3. A replacement seawall would be constructed using clean material in front of the encapsulated material and a cap with geosynthetic liner would be placed on top of the encapsulated material. Figures 3-5a and 3-5b present cross-sections of the encapsulation area and reconstructed seawall.
- 3) The remaining Principal Sources would be loaded onto off-road trucks and transported within the Site boundaries for placement within a containment cell. The proposed location of the containment cell is in the Upland sector in the location shown on Figure 3-3.



Description – Macroencapsulation of Slag

This alternative was developed based on several suggestions at community meetings to contain the source materials with cement/concrete additives and to minimize the size of a containment cell in the Upland area of the Site. This alternative removes the Slag from contact with the bay, moves it to safe inland location in the Park above the groundwater table, and mixes the Slag with cement-like materials (pozzolanic) to fully encapsulate it and prevent degradation and leaching. This alternative addresses several significant concerns at the Site by: 1) eliminating mechanical weathering (erosion) of the Slag by removing the material from wave action, isolating it through Macroencapsulation and capping such that it is no longer in contact with rainfall, surface water or groundwater, 2) minimizing the amount of movement/trucking of the Principal Source materials necessary at the Site, and 3) minimizing the size of the Upland containment cell, which would hold only the lower concentration soil and sediment Principal Sources. This approach allows much of the Principal Source material to remain as close as possible to its original location, minimizing the potential dust and placement concerns associated with moving these materials. The excavated Slag would be placed in an excavated cell within the Park as shown on Figures 3-3, 3-5a and 3-5b, and the void spaces grouted/filled with a cementitious pozzolanic grout. Two possible containment areas are shown; one provides a linear cell that runs parallel with the Seawall and the second is southeast of the existing sewer line. Any non-contaminated soil materials obtained from the Park excavation could be used for backfill or reused as part of the cap cover layer. It is estimated that approximately 6,100 CY of Slag source material would be contained based on EPA's estimate of the quantity of Slag in the seawall; however the size of the Macroencapsulation cell can be adjusted to accommodate a higher volume, if needed.

Similar to Alternative 2A, the Seawall materials would be segregated to retain the clean rip-rap. Following Slag placement and Macroencapsulation, the Park containment area would be capped with a multi-layered capping system including a geomembrane and a geocomposite drainage layer similar to the one shown on Figure 3-4. Following the geosynthetics installation, 2 feet of protective soils and topsoil would be placed which would be suitable for protecting the geosynthetics and establishing vegetation.



This cap would allow existing Park uses to resume following restoration.

Description - Excavation and Upland Containment of Non-Slag Principal Sources

As noted above, most of the non-Slag Principal Sources consists of sand, sediments and soils that have much lower concentrations of lead, arsenic and copper than the Slag. After excavation, the non-Slag Principal Sources would be dewatered as necessary and transported on temporary haul roads within the Site (as described above in connection with Alternative 2A) to an Upland containment cell. A temporary bridge would be required to allow off-road trucking to cross Margaret's Creek.

This alternative includes capping the Upland containment area with a permeable capping system, which would consist of geogrid/construction safety fence visual barrier layer and a 12-inch cover soil layer as shown on Figure 3-6. The synthetic visual barrier layer would be installed to provide a visual barrier to anyone who inadvertently digs in the area as well as vector control below the cover soil layers. Use of a permeable cap is consistent with USEPA guidance for addressing these types of materials, as reflected in the *Superfund Lead-Contaminated Residential Sites Handbook* (USEPA, 2003). Permeable caps are routinely used to contain and isolate lead-contaminated media even at residential properties where children play, and have been used successfully on residential projects in Indiana, Illinois, Missouri and elsewhere around the nation.

The same Pre-Design Investigation described in Alternative 2A would be performed to determine the need for any additional protection from infiltration or leaching of lead from the bottom or sides of the cell.

Following completion of the Seawall replacement and sediment removal activities, Park features (e.g., gazebo, walking paths, fencing etc.) would be restored to existing conditions.



Implementability

Principal Sources Excavation: The implementability of this alternative is the same as Alternative 2A but simplified because of reduced distance of movement of the heavy Slag materials to the Macroencapsulation cell behind the Seawall.

Macroencapsulation: Macroencapsulation has been performed on other sites. A suitable solidification agent would be designated during the design process as alternatives are reviewed.

Upland Containment Cell Construction: Structural fill, cap cover soil, geosynthetics, and topsoil are available for the Upland cell construction as well as geosynthetics for Park cell. The proposed footprint(s) would allow all of the estimated excavated impacted soil and sediment to be placed and capped within the proposed footprints. The actual dimensions and final elevations of the containment cells would be determined during the design process. The size of the final cell will be smaller than the Upland containment cell in Alternative 2A.

Restoration: The disturbed areas of the Site would be restored to existing conditions following removal activities. All restoration is readily implementable including providing the Park, beach and intertidal areas for recreational use. The containment cell areas would also be restored to a vegetative state to prevent erosion and exposure to impacted materials.

Project Duration: The project duration is the same as Alternative 2A.

This alternative can be completed in accordance with the ARARs for the Site provided in Appendix A.

Community Impact: Minimal community impact as described in Alternative 2A with the added benefit that the Upland containment cell would be reduced in size. Also, there would be less material movement on-Site and consequently less dust, noise, truck emissions, etc. Less clean



replacement fill is required than with Alternative 2A so the number of fully loaded trucks on local roads is less with approximately 1,625 trucks required. The estimated off-Site emissions is also less with approximately 609,375 lbs of carbon dioxide equivalents being emitted.

Effectiveness

The effectiveness of this alternative is the same as Alternative 2A, except that encapsulation of the Slag will reduce the long-term maintenance of that containment feature and will provide additional protection against potential contact with surface or groundwater.

In addition, the Macroencapsulation treatment of the Slag provides a beneficial reuse as the massive, buried reinforcement zone behind the Seawall will help prevent erosion from impacting the Park conditions in major storm events.

Cost

The estimated capital cost of this alternative is \$11,852,000. Table 3-3 provides a summary of the costs anticipated for this alternative. This cost estimate does not include the cost of a liner for the Upland cell, the need for which would be determined during the design phase.

3.1.3 Alternative 3: Off-Site Disposal

Description

To address the RAOs stated in Section 2, this alternative consists of the following elements:

- 1) Excavation of the Primary Sources as set forth in Section 1.5.3 above and shown on Figure 1-2 using conventional excavation equipment large enough to remove the Slag pots and large rip-rap. The material would be staged and segregated to retain the clean rip-rap for restoration of the Seawall.



- 2) Treatment of excavated materials as described below, loading onto trucks, transportation to and disposal of materials at an off-Site licensed third party disposal facility.

Due to difficulties and costs associated with crushing the large Slag materials and subsequent treatment, it is anticipated the Slag pots would be excavated and direct loaded onto licensed hazardous waste transport trucks and taken to an off-Site hazardous disposal facility for treatment and disposal. The nearest facilities identified for these materials are located in Yukon, Pennsylvania and Model City, New York, which are located 340 miles and 428 miles away, respectively, as shown in Appendix C. All other materials would be treated as necessary on-Site and then loaded onto trucks and sent off-Site as non-hazardous waste at facilities approximately 50 miles away. This alternative involves the transport of approximately 67,900 tons of hazardous waste (approximately 3,395 full truck loads) and 43,900 tons of non-hazardous waste (approximately 2,195 full truck loads).

Slag-impacted soils and sediments anticipated to be characterized as hazardous would be excavated and segregated in stockpiles to perform waste characterization. Once characterized, materials failing TCLP would be treated on-Site with a stabilization reagent determined through the design process to remove the hazardous characteristics.

In order to perform the stabilization, a large staging area or areas with stabilization cells would be constructed. This staging area and cells would be constructed either in the Park area or in the Upland area of the Site or both. The cells would be constructed with Jersey barriers with erosion and sediment controls installed to prevent migration of impacted materials prior to testing and subsequent loading the treated material into tri-axle haul trucks. Treatment on-Site may create additional dust and noise from mixing operations.



The non-hazardous impacted materials would be excavated and either direct-loaded into trucks or staged for later loading and off-Site disposal to the designated approved non-hazardous waste disposal facility. Clean materials would be brought on-Site to replace excavated materials.

Restoration of all disturbed areas would be completed as discussed in the On-Site Containment Alternatives.

Implementability

The controls (i.e., excavation, treatment and disposal) described under this alternative are demonstrated and proven technologies based on traditional civil and environmental procedures and construction techniques. Such techniques and procedures are reliable and would adequately meet the intended project RAOs. This alternative can be completed in accordance with the ARARs for the Site provided in Appendix A.

The removal of the Principal Sources would be performed with readily available conventional construction equipment. A larger staging area would be required to allow temporary placement, waste characterization of all materials and treatment of hazardous soil/sediment materials prior to transport and disposal at an off-Site disposal facility. The significant amount of material required to be disposed of off-Site would likely overwhelm the capacity at treatment and disposal facilities, which may cause unexpected delays and slow the project down considerably at times. The limited number of licensed hazardous waste transport vehicles would likely further slow implementation of this alternative. The project-related traffic through the community of Old Bridge and on Route 35 (a four lane highway going to two lanes in places with multiple bridges and stop lights), including significant truck traffic during the summer construction season, would likely delay the project and adversely impact the activities of the community and create even more traffic congestion within overloaded community corridors.



Project Duration: Because of the unknown impact of truck and disposal facility availability, traffic and the other factors presented above, it is estimated this alternative will take at least 24 months from the mobilization of construction equipment at the Site, and potentially significantly longer depending upon the impact of significant roadway construction projects in the area, limitations associated with the amount of staging space for trucks on nearby local roads, and limitations associated with availability of hazardous waste haulers and disposal facility capacity. During this time, the Park and most likely the Area 2 and 5 Beaches would not be available for use, due to the requirements of the ongoing staging operations.

Community Impact: The magnitude of off-site trucking may have substantial detrimental impacts to the community. Based on the estimated 111,800 tons of materials that must be taken off-Site for disposal and 74,000 tons of clean materials brought on-site for restoration, approximately 9,290 full truck loads with an equal number of empty truck loads (almost 18,600 in total) would be required to implement this alternative. Each trip would require transport of materials up to 428 miles for a round trip, requiring over one day getting to its intended destination and another day to return for a total of over 2.5 million miles traveled plus an additional 370,000 miles for clean replacement soils for a total of almost 2.9 million miles for this alternative. The main thoroughfare that would be utilized (Route 35) is not amenable for the number of trucks that would be required and has single lane bridges in close proximity to the Site. Estimated off-Site emissions associated with this alternative are 10,867,875 lbs carbon dioxide equivalents.

Traffic congestion and the vehicle accidents that inevitably result are already significant issues in Middlesex County in general and on Route 35 in particular. New Jersey State Police records show that Middlesex County has the highest number of vehicle accidents and the highest number of resulting fatalities of any county in New Jersey. (<http://www.njsp.org/info/fatalacc/pdf/ptccr.pdf>). New Jersey Department of Transportation (NJDOT) records show that Route 35 in particular is consistently among the top 15% of roads in New Jersey with the highest accident rates (<http://www.state.nj.us/transportation/refdata/accident/pdf/crashrate.pdf>). This is not surprising, as



two-lane roads with no shoulder (like Route 35) are among the roadways statistically most prone to accidents. (http://www.state.nj.us/transportation/refdata/accident/pdf/crash_geometry.pdf). The substantial additional truck traffic on Route 35 in Old Bridge that would occur if the Off-Site Disposal Alternative was implemented would exacerbate what already is a difficult situation by creating a significantly increased risk of vehicle accidents. This is supported by statistics which show trucks are the most common type of vehicle in accidents and trucks are 8 times more prone to accidents involving cars compared to single trucks or other vehicles, *Analysis of Truck Accident Reports in Work Zones in New Jersey* (August 1997).

The substantial truck traffic at the Site to implement this alternative also would cause traffic congestion, delays, and additional road maintenance needs resulting from wear and tear on roads from heavy trucks all of which would impact the local businesses and residents of the community. These factors also could have a substantial impact on extending the project schedule. Additionally, the emissions and noise pollution would be significant due to the increased truck traffic.

Effectiveness

With regard to the Principal Sources, effectiveness is the same as Alternatives 2A and 2B except that there would be no long-term maintenance required. However, this alternative presents additional risks not encountered in Alternatives 2A and 2B. The Off-Site Disposal Alternative would involve an estimated 9,290 full truck loads and almost 2.9 million miles to transport materials to the treatment/disposal facility and bring in clean replacement materials, creating a risk of accidents and the potential for exposure of civilians to contaminated material. Because such a significant quantity of material needs to be moved off-Site, the alternative could not be implemented as quickly and this alternative would take at least 24 months to implement and probably much longer due to unforeseen delays. Thus, the Off-Site Disposal Alternative would be less effective in terms of eliminating risks in a timely manner and meeting other goals like reopening public areas as soon as possible.



Once removal was completed, this alternative would eliminate migration pathways and the potential for direct contact exposures to the Principal Sources. As these materials would be removed from the Site, no residual risks would remain from the Principal Sources.

Use of treatment and off-Site disposal is a proven method for addressing materials. It is not normally utilized for significant volumes of materials like those present at the Site. CERCLA (Section 300.430(a)(iii)(B) of the National Contingency Plan) has the expectation that engineering controls like containment would be used for large volumes of waste that pose a relatively low long-term threat where treatment is impractical.

Cost

The estimated capital cost of this alternative is \$20,281,000. Table 3-4 provides a summary of the costs anticipated for this alternative.



4.0 SUMMARY AND COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives for the removal/response action discussed above have been developed based on the project RAOs. These RAOs are to:

- To complete a removal action of Principal Sources that is implementable and an effective component of the final remedy for the Site to the extent practicable;
- To eliminate the potential for contact of recreational users, residents and visitors and ecological receptors to the Principal Sources in the Old Bridge sectors of the Site and reopen the public areas to the public as quickly as possible;
- To eliminate the potential for contact of humans and ecological receptors to soils and sediments with lead concentrations exceeding the Lead PRG; and
- To eliminate the potential for release of constituents from the Principal Source materials via mechanical weathering to soils, sediments or surface water migration pathways.

Alternatives which can meet these goals quickly, are easily implementable, minimize the short term impacts on the community and the environment, will function well over a long period of time, and are cost-effective, are preferred.

A summary of the analysis presented in Section 3.0 for each alternative is provided in Table 4-1 and on Figure 4-1.

4.1 IMPLEMENTABILITY

The No Action Alternative is already implemented, so there are no implementability concerns associated with implementing this remedy. The other three alternatives all are implementable using conventional methods, and the personnel and equipment required to implement these



alternatives are readily available. However, the duration, cost and community impact are significantly different for these alternatives.

The construction time required for the On-Site Containment Alternatives (Alternatives 2A and 2B) is less than the half of the time required for the Off-Site Disposal Alternative (Alternative 3). The implementation of the On-Site Containment Alternatives 2A and 2B would require less coordination with outside parties including trucking companies, local officials, treatment facilities, and disposal facilities. Further, both the On-Site Containment Alternatives 2A and 2B involve movement of substantially less materials through local roads. This in turn, would reduce the potential for an accident, a spill, and dust issues during transport. Off-Site emissions of carbon dioxide equivalents are approximately 10 times higher with Off-Site Disposal Alternative 3 than with either On-Site Containment Alternative 2A or 2B. Community impacts are far less with On-Site Containment Alternatives 2A and 2B than for Off-Site Disposal Alternative 3. For these reasons the On-Site Containment Alternatives 2A and 2B are both preferable with regard to the implementability criterion compared to the Off-Site Disposal Alternative 3.

4.2 EFFECTIVENESS

The No Action Alternative would not be effective in meeting the Site RAOs.

The other three alternatives are equally effective. The On-Site Containment Alternatives 2A and 2B include maintenance components, but maintenance of such containment cells is a traditional, conventional component of response actions, and alternatives involving maintenance components achieve the same level of effectiveness as long as the maintenance is performed.

The On-Site Containment Alternatives 2A and 2B would have less on-Site soil handling and truck traffic during the movement of the Principal Source materials by containing materials close to their present locations. The Off-Site Disposal Alternative would require additional material handling and mixing of impacted soil/sediment with treatment reagents in order to transport the treated, non-Slag Principal Source materials to a subtitle D disposal facility. This additional material handling and mixing would increase the potential for dust and noise. Additionally, the



On-Site Containment Alternatives 2A and 2B would have substantially less off-Site trucking requirements as all Principal Source materials would be contained on-Site either by a cap alone or by a cap with additional Macroencapsulation treatment. The Off-Site Disposal Alternative 3 would require 111,800 tons of material to be taken off-Site and the import of 74,000 tons of clean, replacement soils. This equates to a total of approximately 9,290 loads of off-Site trucks to transport the Principal Sources hundreds of miles to the disposal facilities located in Yukon, Pennsylvania and/or Model City, New York and bring in clean materials. These thousands of trucks will have to line up and be staged on local roads near the Site to receive materials for off-Site disposal or wait to unload clean materials. The increased traffic and mileage, including the almost 2.9 million miles necessary to truck the materials to the disposal sites, would significantly increase the potential for vehicle accidents, congest local roadways, and create noise and emission pollution, all of which would detrimentally impact local residents and businesses. Table 3-1 provides an estimate of the number trucks required for each alternative as well as the estimated mileage.

Time of construction for the On-Site Containment Alternatives 2A and 2B is estimated to be just 6 to 12 months. These alternatives are projected to have a manageable impact on the local community because nearly all activity is on-Site. In contrast, the Off-Site Disposal Alternative 3 is estimated to take at least 24 months and could take even longer, which would delay meeting the project goals of eliminating risks in a timely manner and other project goals like opening the beach and Park for community use as soon as possible.

All of the alternatives are equally protective of human health and the environment. The Alternative 2B Macroencapsulation of the Slag would add a pozzolanic layer over the materials which would provide an additional protection against future contact of those materials with surface or groundwater. Further, the Alternative 2B Macroencapsulation and the pozzolonic reinforcement take advantage of massive nature of the existing Slag pots, which have survived over 40 years, to serve as a massive reinforcement zone to prevent the Park and the sewer main from becoming damaged in the event of a severe storm or erosion which damages the Seawall.



4.3 COST

There is no significant cost associated with the No Action Alternative. The estimates of the probable construction cost of the On-Site Containment Alternative 2A and the Macroencapsulation Alternative 2B are similar at approximately \$11,275,000 and \$11,852,000 dollars, respectively (i.e., the cost of those alternatives are within about 10% of each other). The estimate of probable construction cost of the Off-Site Disposal Alternative 3 is almost double this cost at \$20,281,000.

4.4 COMPARATIVE ANALYSIS SUMMARY

With the exception of No Action, all of the alternatives can meet the RAOs and are equally effective. However, the On-Site Containment Alternative 2A and the On-Site Macroencapsulation Alternative 2B meet the project RAOs more quickly, with fewer risks associated with transportation, with less traffic, noise, dust and carbon dioxide equivalents emissions and other detrimental impacts on the community, and at a substantially lower cost than Alternative 3. The On-Site Containment Alternative 2A and the On-Site Macroencapsulation Alternative 2B are therefore more implementable than Alternative 3.



5.0 REFERENCES

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Advanced GeoServices, March 2012, Comments to the National Remedy Review Board, West Chester, Pennsylvania

CDM Smith, December 2011, Final Remedial Investigation Report, New York, New York

CDM Smith, February 2012, Final Feasibility Study Report, New York, New York

USEPA, September 1999, Presumptive Remedy for Metals-in-Soil Sites, OSWER-9355.0-72FS

USEPA, August 2003, Superfund Lead-Contaminated Residential Sites Handbook, OSWER 9285.7-50

USEPA, February 2012, Methodology for Understanding and Reducing a Project's Environmental Footprint, EPA 542-R-12-002

The National Center for Transportation and Industrial Productivity, Institute for Transportation, and New Jersey Institute of Technology, August 1997, Analysis of Truck Accident Reports in Work Zones in New Jersey

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TABLES

Table 2-1
Estimated Volumes and Tonnage
RBS Superfund Site
Middlesex County, New Jersey



	Source Materials Volume	Source Materials Weight	Soil Volume	Soil Weight	Sediment Volume	Sediment Wt.	Total Volume	Total Weight
	CY	Ton	CY	Ton	CY	Ton	CY	Ton
Seawall Sector								
Area 1	15,000	64,500	4,612	6,918	2,349	3,993	21,961	75,411
Area 2	59	254	4,799	7,199	3,205	5,449	8,063	12,901
Area 3	-	-	-	-	-	-	-	-
Area 4	-	-	-	-	-	-	-	-
Area 5	9	39	1,113	1,670	1,579	2,684	2,701	4,393
Area 6	-	-	-	-	-	-	-	-
Total	15,100	64,800	10,500	15,800	7,100	12,100	32,700	92,700
Margaret's Creek Sector								
Area 9	711	3,057	5,000	7,500	5,000	8,500	10,711	19,057
Total All Sectors	15,800	67,900	15,500	23,300	12,100	20,600	43,400	111,800
Notes: 1. All volumes based on EPA sampling and a PRG of 232 mg/kg total lead. 2. Tons based on volumes shown with 4.3 tons/cy for source materials, 1.5 tons/cy for soils, and 1.7 tons/cy for sediments.								

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**Table 3-1
Truck Volume Summary
RBS Superfund Site
Middlesex County, New Jersey**



Alternative	Type of Material	Material (tons)	Number of Loaded Trucks On-site	Number of Loaded Trucks on Local Roads	Miles per Trip	Miles traveled	Carbon Dioxide Equivalent CO ₂ e (lbs.)
On-site Containment	Replacement fill	44,000	1,100		Available on-site	-	
	Replacement fill (rip rap)	30,000		1,500	100	150,000	562,500
	Structural fill for berms	18,000	450		Available on-site	-	
	Cap cover soils	19,000		950	100	95,000	356,250
Totals		111,000	1,550	2,450		245,000	918,750
Macroencapsulation	Replacement fill	44,000	1,100		Available on-site	-	
	Replacement fill (rip rap)	30,000		1,500	100	150,000	562,500
	Structural fill for berms	20,000	500		Available on-site	-	
	Cap cover soils	36,300	908		Available on-site	-	
	Solidification Reagents	2,500		125	100	12,500	46,875
	Totals	132,800	2,508	1,625		162,500	609,375
Off-site Disposal	Source materials (haz facility)	67,900		3,395	680	2,308,600	8,657,250
	Sediment/soils (non-haz facility)	43,900		2,195	100	219,500	823,125
	Replacement fill	74,000		3,700	100	370,000	1,387,500
	Totals	185,800	0	9,290		2,898,100	10,867,875

Notes:

1. Hazardous Disposal Facility assumed to be Yukon, Pennsylvania.
2. Import fill and non-hazardous facility assumed to be within 50-mile range.
3. Tonnage based on volume excavations and tons/cy multipliers.
4. Return trip empty trucks not included.
5. Miles calculated on round trip of fully loaded trucks and return trip of empty trucks
6. Carbon Dioxide Equivalent conversion factor (22.5 lbs per gal) was attained from USEPA's "Methodology for Understanding and Reducing a Project's Environmental Footprint"
7. Six miles per gallon used for diesel trucking (assuming a round trip).

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Table 3-2
Alternative 2A
On-Site Containment Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Mobilization/Demobilization	1	LS	\$ 250,000.00	\$ 250,000.00	\$ 250,000.00
Pre-Design Investigation	1	LS	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00
Demolition					
- Tree Removal and Grubbing	2	Ac	\$ 9,825.00	\$ 19,650.00	
- Misc	1	LS	\$ 5,000.00	\$ 5,000.00	
- Site Lighting - removed and stored	27	EA	\$ 200.00	\$ 5,400.00	
- Fencing	3,300	LF	\$ 3.78	\$ 12,474.00	
- Guiderail	522	LF	\$ 2.81	\$ 1,466.82	
- Guiderail Posts	55	EA	\$ 7.00	\$ 385.00	
- Playground equipment	1	LS	\$ 1,000.00	\$ 1,000.00	
- Gazebo	2,560	CF	\$ 0.35	\$ 896.00	
- Walking Bridge Partial Demo	400	SF	\$ 12.45	\$ 4,980.00	
					\$ 51,251.82
Erosion Control - General Site					
- Construction Entrance	1	EA	\$ 1,600.00	\$ 1,600.00	
- Super Silt Fence	3,200	LF	\$ 8.00	\$ 25,600.00	
- Perm Seed/Mulch (Cap)	259,011	SF	\$ 0.12	\$ 31,081.32	
					\$ 58,281.32
Erosion Control - Coastal					
- Silt curtain	2,700	LF	\$ 20.00	\$ 54,000.00	
- Dewatering Station and Water Management	1	LS	\$ 50,000.00	\$ 50,000.00	
- Management/Maintenance	1	LS	\$ 20,000.00	\$ 20,000.00	
					\$ 124,000.00
Earthwork					
General Site					
- Strip Topsoil and Stockpile	4,250	CY	\$ 4.00	\$ 17,000.00	
					\$ 17,000.00
Containment Area - MC Sector					
- Bulk Fill for Containment Area Subgrade - Imported	12,000	CY	\$ 25.00	\$ 300,000.00	
- Cap Liner	255,000	SF	\$ 3.00	\$ 765,000.00	
- Cap Cover Soil - Imported	12,000	CY	\$ 30.00	\$ 360,000.00	
- Topsoil	5,000	CY	\$ 26.00	\$ 130,000.00	
					\$ 1,555,000.00
Removal of Soil and Near Shore Sediment - Seawall Sector					
- Excavate and Manage Bay Sediments	7,100	CY	\$ 50.00	\$ 355,000.00	
- Backfill Bay Sediment Excavation	7,100	CY	\$ 26.00	\$ 184,600.00	
- Excavate Existing Beach Soil and Soil Underlying Slag Pots	10,500	CY	\$ 20.00	\$ 210,000.00	
- Backfill Existing Beach Excavation	10,500	CY	\$ 26.00	\$ 273,000.00	
					\$ 1,022,600.00
Removal of Seawall					
- Excavate Riprap to 5'; Haul and Place	15,000	CY	\$ 50.00	\$ 750,000.00	
- Backfill Excavation below seawall	10,000	CY	\$ 26.00	\$ 260,000.00	
- Procure and Replace Riprap	5,000	CY	\$ 210.00	\$ 1,050,000.00	
					\$ 2,060,000.00
Removal of MC source Materials					
- Excavate Source Soils - Haul - Place	711	CY	\$ 26.00	\$ 18,486.00	
- Excavate Miscellaneous Impacted Soils - Haul - Place	10,000	CY	\$ 27.00	\$ 270,000.00	
- Backfill Excavated Areas	10,000	CY	\$ 26.00	\$ 260,000.00	
					\$ 548,486.00

Table 3-2
Alternative 2A
On-Site Containment Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Stream Crossing					
- Foundations	128	CY	\$ 266.00	\$ 34,048.00	
- Precast bridge spans	1	LS	\$ 75,000.00	\$ 75,000.00	
- Backfill to 18" above top	3,500	CY	\$ 26.00	\$ 91,000.00	
					\$ 200,048.00
Park Re-Construction					
- Parking Lot					
6" Stone Subbase	1,225	SY	\$ 10.50	\$ 12,864.83	
2" Binder	1,225	SY	\$ 15.00	\$ 18,378.33	
1.5" Wearing	1,225	SY	\$ 12.00	\$ 14,702.67	
- Woodpost Guiderail	550	LF	\$ 30.00	\$ 16,500.00	
- Gates	2	EA	\$ 3,000.00	\$ 6,000.00	
- Signage	15	EA	\$ 300.00	\$ 4,500.00	
- Paved path (1.5" Wearing 6" Stone)	3,800	SY	\$ 25.00	\$ 95,000.00	
- Walking Bridge Modifications	1	LS	\$ 20,000.00	\$ 20,000.00	
- Reinstall Lighting on New Foundations	27	EA	\$ 1,500.00	\$ 40,500.00	
- Site Lighting - Additional Lights	10	EA	\$ 4,500.00	\$ 45,000.00	
- Conduit and wiring for lighting	3,000	LF	\$ 5.00	\$ 15,000.00	
- Deciduous Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Evergreen Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Deciduous Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Evergreen Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Playground and Equipment	8,000	SF	\$ 15.00	\$ 120,000.00	
- Picnic Tables	6	EA	\$ 1,500.00	\$ 9,000.00	
- Benches	10	EA	\$ 1,200.00	\$ 12,000.00	
					\$ 549,445.83
Structures					
- Bay Overlook	2	EA	\$ 20,000.00	\$ 40,000.00	
- Gazebo	1	EA	\$ 20,000.00	\$ 20,000.00	
					\$ 60,000.00
Upgrades to Haul Road					\$ 100,000.00
Contractor's Oversight and Project Management					\$ 1,500,000.00
Final Design and Permitting					\$ 450,000.00
Engineering Oversight, Sampling, and Final Report					\$ 750,000.00
					Subtotal without Contingency \$ 9,396,112.97
Contingency (20%)					\$ 1,879,222.59
					TOTAL \$ 11,275,335.57

Table 3-3
Alternative 2B
Macroencapsulation Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Mobilization/Demobilization	1	LS	\$ 250,000.00	\$ 250,000.00	\$ 250,000.00
Pre-Design Investigation	1	LS	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00
Demolition					
- Tree Removal and Grubbing	2	Ac	\$ 9,825.00	\$ 19,650.00	
- Misc	1	LS	\$ 5,000.00	\$ 5,000.00	
- Site Lighting - removed and stored	27	EA	\$ 200.00	\$ 5,400.00	
- Fencing	3,300	LF	\$ 3.78	\$ 12,474.00	
- Guiderail	522	LF	\$ 2.81	\$ 1,466.82	
- Guiderail Posts	55	EA	\$ 7.00	\$ 385.00	
- Playground equipment	1	LS	\$ 1,000.00	\$ 1,000.00	
- Gazebo	2,560	CF	\$ 0.35	\$ 896.00	
- Walking Bridge Partial Demo	400	SF	\$ 12.45	\$ 4,980.00	
					\$ 51,251.82
Erosion Control - General Site					
- Construction Entrance	1	EA	\$ 1,600.00	\$ 1,600.00	
- Super Silt Fence	3,200	LF	\$ 8.00	\$ 25,600.00	
- Perm Seed/Mulch (Cap)	259,011	SF	\$ 0.12	\$ 31,081.32	
					\$ 58,281.32
Erosion Control - Coastal					
- Silt curtain	2,700	LF	\$ 20.00	\$ 54,000.00	
- Dewatering Station and Water Management	1	LS	\$ 50,000.00	\$ 50,000.00	
- Management/Maintenance	1	LS	\$ 20,000.00	\$ 20,000.00	
					\$ 124,000.00
Earthwork					
General Site					
- Strip Topsoil and Stockpile	4,250	CY	\$ 4.00	\$ 17,000.00	
					\$ 17,000.00
Containment Areas - Old Bridge Waterfront Park					
- Cementitious flowable fill	5,000	CY	\$ 95.00	\$ 475,000.00	
- Cap Liner	58,000	SF	\$ 3.00	\$ 174,000.00	
- Cap Cover Soil - imported	5,000	CY	\$ 30.00	\$ 150,000.00	
- Topsoil	2,500	CY	\$ 26.00	\$ 65,000.00	
					\$ 864,000.00
Containment Area - MC Sector					
- Bulk Fill for Containment Area Subgrade - imported	12,000	CY	\$ 25.00	\$ 300,000.00	
- Visual Barrier Layer	255,000	SF	\$ 1.00	\$ 255,000.00	
- Cap Cover Soil - imported	12,000	CY	\$ 30.00	\$ 360,000.00	
- Topsoil	5,000	CY	\$ 26.00	\$ 130,000.00	
					\$ 1,045,000.00
Removal of Soil and Near Shore Sediment - Seawall Sector					
- Excavate and Manage Bay Sediments	7,100	CY	\$ 50.00	\$ 355,000.00	
- Backfill Bay Sediment Excavation	7,100	CY	\$ 26.00	\$ 184,600.00	
- Excavate Existing Beach Soil and Soil Underlying Slag Pots	10,500	CY	\$ 20.00	\$ 210,000.00	
- Backfill Existing Beach Excavation	10,500	CY	\$ 26.00	\$ 273,000.00	
					\$ 1,022,600.00
Removal of Seawall					
- Excavate Riprap to 5'; Haul and Place	15,000	CY	\$ 50.00	\$ 750,000.00	
- Backfill Excavation below seawall	10,000	CY	\$ 26.00	\$ 260,000.00	
- Procure and Replace Riprap	5,000	CY	\$ 210.00	\$ 1,050,000.00	
					\$ 2,060,000.00
Removal of MC source Materials					
- Excavate Source Soils - Haul - Place	711	CY	\$ 26.00	\$ 18,486.00	
- Excavate Miscellaneous Impacted Soils - Haul - Place	10,500	CY	\$ 27.00	\$ 283,500.00	
- Backfill Excavated Areas	10,500	CY	\$ 26.00	\$ 273,000.00	
					\$ 574,986.00

Table 3-3
Alternative 2B
Macroencapsulation Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Stream Crossing					
- Foundations	128	CY	\$ 266.00	\$ 34,048.00	
- Precast bridge spans	1	LS	\$ 75,000.00	\$ 75,000.00	
- Backfill to 18" above top	3,500	CY	\$ 26.00	\$ 91,000.00	
					\$ 200,048.00
Relocate Forcemain					
- Remove and Replace 20-inch diameter water line	500	LF	\$ 200.00	\$ 100,000.00	
					\$ 100,000.00
Park Re-Construction					
- Parking Lot					
6" Stone Subbase	1,225	SY	\$ 10.50	\$ 12,864.83	
2" Binder	1,225	SY	\$ 15.00	\$ 18,378.33	
1.5" Wearing	1,225	SY	\$ 12.00	\$ 14,702.67	
- Woodpost Guiderail	550	LF	\$ 30.00	\$ 16,500.00	
- Gates	2	EA	\$ 3,000.00	\$ 6,000.00	
- Signage	15	EA	\$ 300.00	\$ 4,500.00	
- Paved path (1.5" Wearing 6" Stone)	3,800	SY	\$ 25.00	\$ 95,000.00	
- Walking Bridge Modifications	1	LS	\$ 20,000.00	\$ 20,000.00	
- Reinstall Lighting on New Foundations	27	EA	\$ 1,500.00	\$ 40,500.00	
- Site Lighting - Additional Lights	10	EA	\$ 4,500.00	\$ 45,000.00	
- Conduit and wiring for lighting	3,000	LF	\$ 5.00	\$ 15,000.00	
- Deciduous Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Evergreen Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Deciduous Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Evergreen Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Playground and Equipment	8,000	SF	\$ 15.00	\$ 120,000.00	
- Picnic Tables	6	EA	\$ 1,500.00	\$ 9,000.00	
- Benches	10	EA	\$ 1,200.00	\$ 12,000.00	
					\$ 549,445.83
Structures					
- Bay Overlook	2	EA	\$ 20,000.00	\$ 40,000.00	
- Gazebo	1	EA	\$ 20,000.00	\$ 20,000.00	
					\$ 60,000.00
Upgrades to Haul Road					\$ 100,000.00
Contractor's Oversight and Project Management					\$ 1,500,000.00
Final Design and Permitting					\$ 450,000.00
Engineering Oversight, Sampling, and Final Report					\$ 750,000.00
					Subtotal without Contingency \$ 9,876,612.97
Contingency (20%)					\$ 1,975,322.59
					TOTAL \$ 11,851,935.57

Table 3-4
Alternative 3
Off-Site Disposal Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Mobilization/Demobilization	1	LS	\$ 250,000.00	\$ 250,000.00	\$ 250,000.00
Pre-Design Investigation	1	LS	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00
Demolition					
- Tree Removal and Grubbing	2	Ac	\$ 9,825.00	\$ 19,650.00	
- Misc	1	LS	\$ 5,000.00	\$ 5,000.00	
- Site Lighting - removed and stored	27	EA	\$ 200.00	\$ 5,400.00	
- Fencing	3,300	LF	\$ 3.78	\$ 12,474.00	
- Guiderail	522	LF	\$ 2.81	\$ 1,466.82	
- Guiderail Posts	55	EA	\$ 7.00	\$ 385.00	
- Playground equipment	1	LS	\$ 1,000.00	\$ 1,000.00	
- Gazebo	2,560	CF	\$ 0.35	\$ 896.00	
- Walking Bridge Partial Demo	400	SF	\$ 12.45	\$ 4,980.00	
					\$ 51,251.82
Erosion Control - General Site					
- Construction Entrance	1	EA	\$ 1,600.00	\$ 1,600.00	
- Super Silt Fence	3,200	LF	\$ 8.00	\$ 25,600.00	
- Perm Seed/Mulch (Cap)	259,011	SF	\$ 0.12	\$ 31,081.32	
					\$ 58,281.32
Erosion Control - Coastal					
- Silt curtain	2,700	LF	\$ 20.00	\$ 54,000.00	
- Dewatering Station and Water Management	1	LS	\$ 50,000.00	\$ 50,000.00	
- Management/Maintenance	1	LS	\$ 20,000.00	\$ 20,000.00	
					\$ 124,000.00
Earthwork					
General Site					
- Strip Topsoil and Stockpile	4,250	CY	\$ 4.00	\$ 17,000.00	
					\$ 17,000.00
Removal of Soil and Near Shore Sediment - Seawall Sector					
- Excavate and Manage Bay Sediments	7,100	CY	\$ 50.00	\$ 355,000.00	
- Backfill Bay Sediment Excavation	7,100	CY	\$ 26.00	\$ 184,600.00	
- Excavate Existing Beach Soil and Soil Underlying Slag Pots	10,500	CY	\$ 20.00	\$ 210,000.00	
- Backfill Existing Beach Excavation	10,500	CY	\$ 26.00	\$ 273,000.00	
					\$ 1,022,600.00
Removal of Seawall					
- Excavate Riprap to 5'; Haul and Place	15,000	CY	\$ 50.00	\$ 750,000.00	
- Backfill Excavation below seawall	10,000	CY	\$ 26.00	\$ 260,000.00	
- Procure and Replace Riprap	5,000	CY	\$ 210.00	\$ 1,050,000.00	
					\$ 2,060,000.00
Removal of MC source Materials					
- Excavate Source Soils - Haul - Place	711	CY	\$ 26.00	\$ 18,486.00	
- Excavate Miscellaneous Impacted Soils - Haul - Place	10,000	CY	\$ 27.00	\$ 270,000.00	
- Backfill Excavated Areas	10,000	CY	\$ 26.00	\$ 260,000.00	
					\$ 548,486.00

Table 3-4
Alternative 3
Off-Site Disposal Cost Opinion
RBS Superfund Site
Middlesex County, New Jersey



Item Description	Quantity	Unit	Unit Rate	Amount	Subtotal
Transportation and Offsite Disposal					
- Waste Characterization	1	LS	\$ 50,000.00	\$ 50,000.00	
- Onsite Treatment of Hazardous Soil/Sediment Waste	7,500	Ton	\$ 40.20	\$ 301,500.00	
- Transportation and Disposal of Slag at Hazardous Disposal Facility	26,157	Ton	\$ 202.81	\$ 5,304,901.17	
- Transportation and Disposal of Soil/Sediment at Non-haz Disposal Facility	41,000	Ton	\$ 83.00	\$ 3,403,000.00	
					\$ 9,059,401.17
Stream Crossing					
- Foundations	128	CY	\$ 266.00	\$ 34,048.00	
- Precast bridge spans	1	LS	\$ 75,000.00	\$ 75,000.00	
- Backfill to 18" above top	3,500	CY	\$ 26.00	\$ 91,000.00	
					\$ 200,048.00
Park Re-Construction					
- Parking Lot					
6" Stone Subbase	1,225	SY	\$ 10.50	\$ 12,864.83	
2" Binder	1,225	SY	\$ 15.00	\$ 18,378.33	
1.5" Wearing	1,225	SY	\$ 12.00	\$ 14,702.67	
- Woodpost Guiderail	550	LF	\$ 30.00	\$ 16,500.00	
- Gates	2	EA	\$ 3,000.00	\$ 6,000.00	
- Signage	15	EA	\$ 300.00	\$ 4,500.00	
- Paved path (1.5" Wearing 6" Stone)	3,800	SY	\$ 25.00	\$ 95,000.00	
- Walking Bridge Modifications	1	LS	\$ 20,000.00	\$ 20,000.00	
- Reinstall Lighting on New Foundations	27	EA	\$ 1,500.00	\$ 40,500.00	
- Site Lighting - Additional Lights	10	EA	\$ 4,500.00	\$ 45,000.00	
- Conduit and wiring for lighting	3,000	LF	\$ 5.00	\$ 15,000.00	
- Deciduous Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Evergreen Trees	60	EA	\$ 500.00	\$ 30,000.00	
- Deciduous Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Evergreen Shrubs	120	EA	\$ 250.00	\$ 30,000.00	
- Playground and Equipment	8,000	SF	\$ 15.00	\$ 120,000.00	
- Picnic Tables	6	EA	\$ 1,500.00	\$ 9,000.00	
- Benches	10	EA	\$ 1,200.00	\$ 12,000.00	
					\$ 549,445.83
Structures					
- Bay Overlook	2	EA	\$ 20,000.00	\$ 40,000.00	
- Gazebo	1	EA	\$ 20,000.00	\$ 20,000.00	
					\$ 60,000.00
Upgrades to Haul Road					\$ 100,000.00
Contractor's Oversight and Project Management					\$ 1,500,000.00
Final Design and Permitting					\$ 450,000.00
Engineering Oversight, Sampling, and Final Report					\$ 750,000.00
Subtotal without Contingency					\$ 16,900,514.14
Contingency (20%)					\$ 3,380,102.83
TOTAL					\$ 20,280,616.97

Table 4-1
Alternative Implementability, Effectiveness and Cost Summary
RBS Superfund Site
Middlesex County, New Jersey



Alternative	Implementability	Long-Term Effectiveness	Cost
1 No Action	Fully Implementable <ul style="list-style-type: none"> Relies on maintaining existing fences, signage and warnings to community 	Minimally Effective <ul style="list-style-type: none"> No removal of sources; erosion and weathering of sources may continue Relies on barriers (fences/signs) to prevent human exposure to sources No reduction in exposures to environmental receptors Beach and seawall area continue to be unavailable for recreational users 	Minimal
2A On-Site Containment	Fully Implementable <ul style="list-style-type: none"> Removal and containment of sources takes place on-Site within defined construction zone Equipment available and conventional Ample space available for containment cell outside the 100-year floodplain Minimizes community impacts <ul style="list-style-type: none"> Minimizes traffic on public roads <ul style="list-style-type: none"> 2450 truck loads on public roads to bring in clean materials Minimizes risks of traffic accidents and damage to public roads 245,000 off-site truck miles required 918,750 lbs Carbon Dioxide Equivalent (CO₂e) Beach, park and seawall areas reopened more quickly than with Alternative 3 Can be conducted in compliance with ARARs 6-12 months of active construction to implement Maintenance of containment cell over time is conventional and routine 	Fully Effective <ul style="list-style-type: none"> Removal of sources and impacted soils and sediments >232 mg/kg lead Eliminates direct contact/exposure of humans and ecological receptors to sources and media > 232 mg/kg lead Eliminates further weathering/erosion of source materials Containment cell designed to eliminate movement of impacted materials to soils, surface and groundwater Containment cell designed to effectively manage stormwater Requires long-term monitoring and maintenance of containment cell Maintenance of containment cell over time is conventional and routine 	\$11,275,335.00
2B Park Macroencapsulation and Permeable Upland Cap	Fully Implementable <ul style="list-style-type: none"> Removal and containment of sources takes place on-Site within defined construction zone Equipment available and conventional Less on-Site movement of slag compared to Alternatives 2A and 3 Encapsulation process/additive for slag is conventional Ample space available for containment cell outside the 100-year floodplain Minimizes community impacts <ul style="list-style-type: none"> Minimizes traffic on public roads <ul style="list-style-type: none"> 1625 truck loads on public roads to bring in clean materials Minimizes risks of traffic accidents and damage to public roads 162,500 off-site truck miles required 609,375 lbs Carbon Dioxide Equivalent (CO₂e) Beach, park and seawall areas reopened more quickly than with Alternative 3 Can be conducted in compliance with ARARs 6-12 months of active construction to implement Maintenance of containment cell over time is conventional and routine 	Fully Effective <ul style="list-style-type: none"> Removal of sources and impacted soils and sediments >232 mg/kg lead Eliminates direct contact/exposure of humans and ecological receptors to sources and media > 232 mg/kg lead Eliminates further weathering/erosion of source materials Takes advantage of the massive nature of encapsulated slag pots to further stabilize park area Encapsulation area designed to effectively manage stormwater Upland containment cell reduced in size compared to Alternative 2A Containment cell designed to eliminate movement of impacted materials to soils, surface and groundwater Containment cell designed to effectively manage stormwater Requires long-term monitoring and maintenance of containment cell Maintenance of containment cell over time is conventional and routine 	\$11,851,935.00
3 Off-Site Disposal	Fully Implementable <ul style="list-style-type: none"> Removal and treatment of soil/sediment conducted on-Site; transport, treatment of slag and disposal of all material conducted off-site On-site equipment available and conventional Lack of available off-site disposal trucks and facility capacity may delay completion of project High community impacts <ul style="list-style-type: none"> High volume of traffic on public roads <ul style="list-style-type: none"> 9,290 truck loads on public roads (5600 impacted materials, 3700 replacement materials) 2,900,000 truck roadway miles required 10,867,875 lbs Carbon Dioxide Equivalent (CO₂e) Increased risks of traffic accidents and damage to public roads Increased dust, noise, exhaust in community Beach, park and seawall areas reopened less quickly than with Alternatives 2A or 2B Can be conducted in compliance with ARARs Minimum of 24 months of active construction to implement 	Fully Effective <ul style="list-style-type: none"> Removal of sources and impacted soils and sediments >232 mg/kg lead Eliminates direct contact/exposure of humans and ecological receptors to sources and media > 232 mg/kg lead Eliminates further weathering/erosion of source materials No long-term monitoring or maintenance required 	\$20,280,617.00

NL-RBS 000211



FIGURES



<p>Figure 1-1</p>	<p>RBS SUPERFUND SITE</p> <p>MIDDLESEX COUNTY, NEW JERSEY</p>	<p>ADVANCED Geoservices</p> <p>Engineering for the Environment, Planning for People.</p> <p>1000 ANDREW DRIVE, SUITE A, WEST CHESTER PA, 19380 tel 810.840.9100 fax 810.840.9109 www.advancedgeoservices.com</p>	<p>SITE LOCATION MAP</p> <table border="1"> <tr> <td>PROJECT MANAGER:</td><td>C.T.R.</td><td>SCALE:</td><td>1" = 800'</td></tr> <tr> <td>CHECKED BY:</td><td>B.L.F.</td><td>PROJECT NUMBER:</td><td>2007-1973</td></tr> <tr> <td>DRAWN BY:</td><td>K.O.</td><td>DATE:</td><td></td></tr> </table>	PROJECT MANAGER:	C.T.R.	SCALE:	1" = 800'	CHECKED BY:	B.L.F.	PROJECT NUMBER:	2007-1973	DRAWN BY:	K.O.	DATE:	
PROJECT MANAGER:	C.T.R.	SCALE:	1" = 800'												
CHECKED BY:	B.L.F.	PROJECT NUMBER:	2007-1973												
DRAWN BY:	K.O.	DATE:													

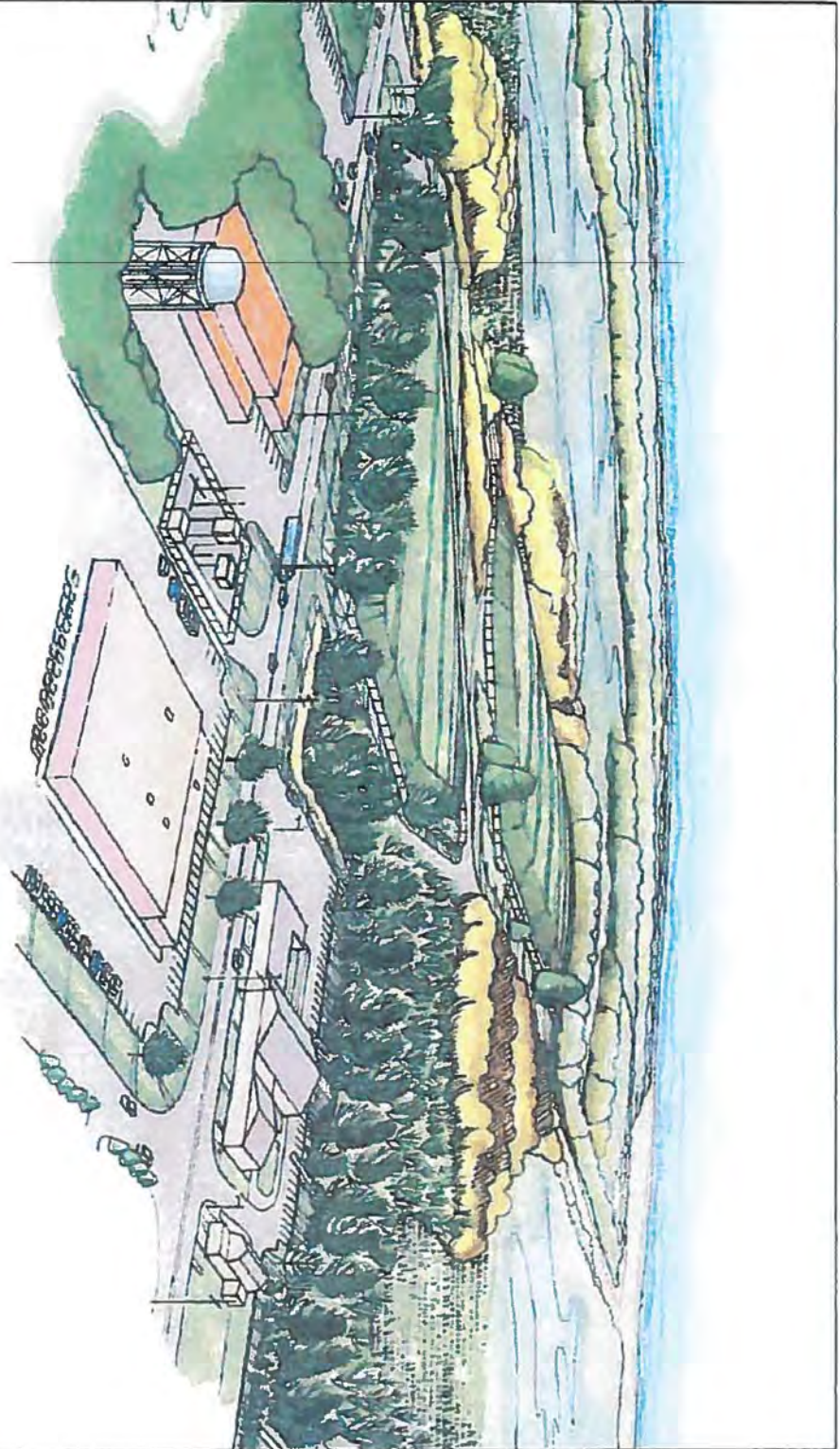
NOTES:
 1. SCALE IS APPROXIMATE
 2. AERIAL VIEW DATED 2007
 3. LOCATIONS OF EXCAVATION AREAS BASED ON EPA FS
 4. ARE APPROXIMATE
 4. APPROXIMATE FORAGING AREAS HAVE NOT BEEN APPLIED
 FOR THE SELECTED ECOLOGICAL RECEPTOR



1-2 Figure	RBS SUPERFUND SITE	ADVANCED Geoservices <i>Engineering for the Environment. Planning for People.™</i> 1005 ANDREW DRIVE, SUITE A, WEST CHESTER PA, 19380 tel 870.346.1100 fax 870.346.1100 www.advancedgeoservices.com	AREAS TO BE ADDRESSED UNDER EE/CA MARGARET'S CREEK AND SEAWALL SECTOR	
	MIDDLESEX COUNTY, NEW JERSEY		PROJECT MANAGER: C.T.R.	SCALE: 1" = 400'
			CHECKED BY: B.L.F.	PROJECT NUMBER: 2007-1973
			DRAWN BY: K.E.K.	DATE:



Project: 2007-1973-Margaret's Creek
 Date: 10/1/2007
 User: J. L. Smith
 Title: CECA Figure 2.dwg
 Plot Date: 10/1/2007



DRAFT
 Figure 2
 Margaret's Creek Containment Cell
 Raritan Bay Slag Superfund Site
 Old Bridge/Sayreville, New Jersey

Figure
 3-2

RBS SUPERFUND SITE

MIDDLESEX COUNTY, NEW JERSEY



Engineering for the Environment. Planning for People.TM
 1005 ANDREW DRIVE, SUITE A, WEST CHESTER PA, 19380
 Tel: 610.681.8700 Fax: 610.681.8710 www.advancedgeoservices.com

EPA RENDERING OF
 UPLAND CONTAINMENT CELL

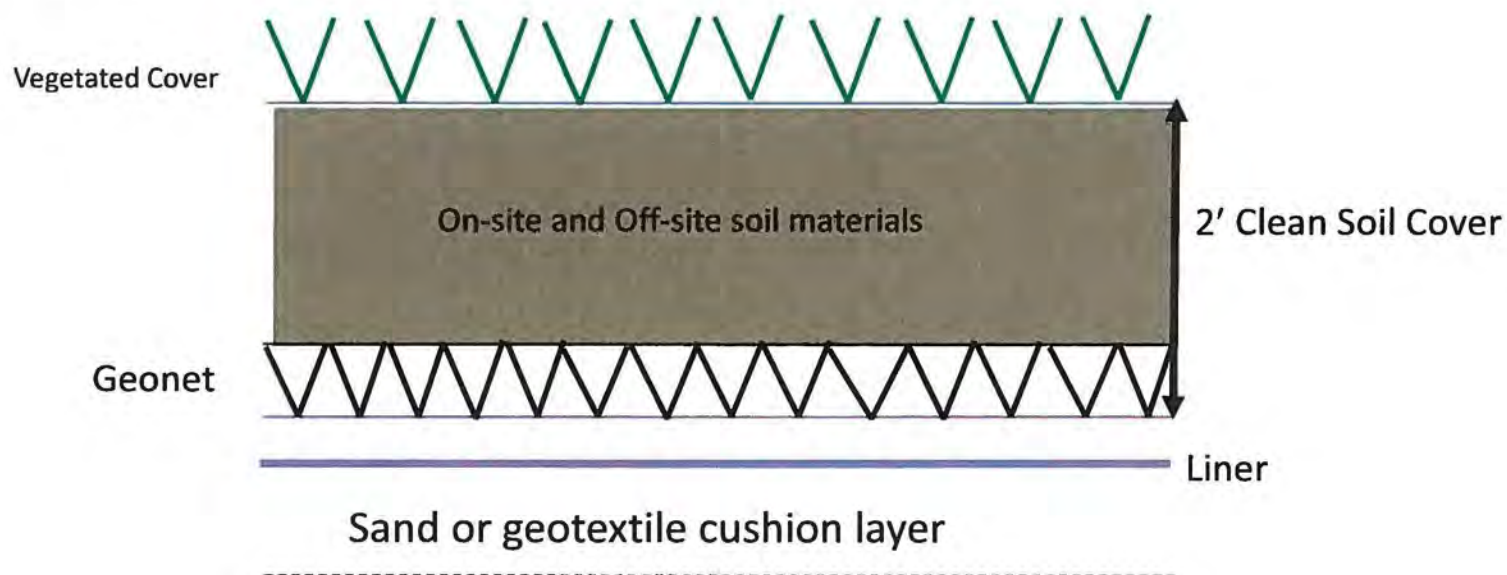
PROJECT MANAGER: C.T.R.	SCALE: NO SCALE
CHECKED BY: B.L.F.	PROJECT NUMBER: 2007-1973
DRAWN BY: K.O.	DATE:

NL-RBS 000216



FIGURE 3-4

Upland Containment Area Cap Cross-Section



Consolidated Soils, Sediments
and Slag Materials

FIGURE 3-5a

Macroencapsulation Cross-Section #1

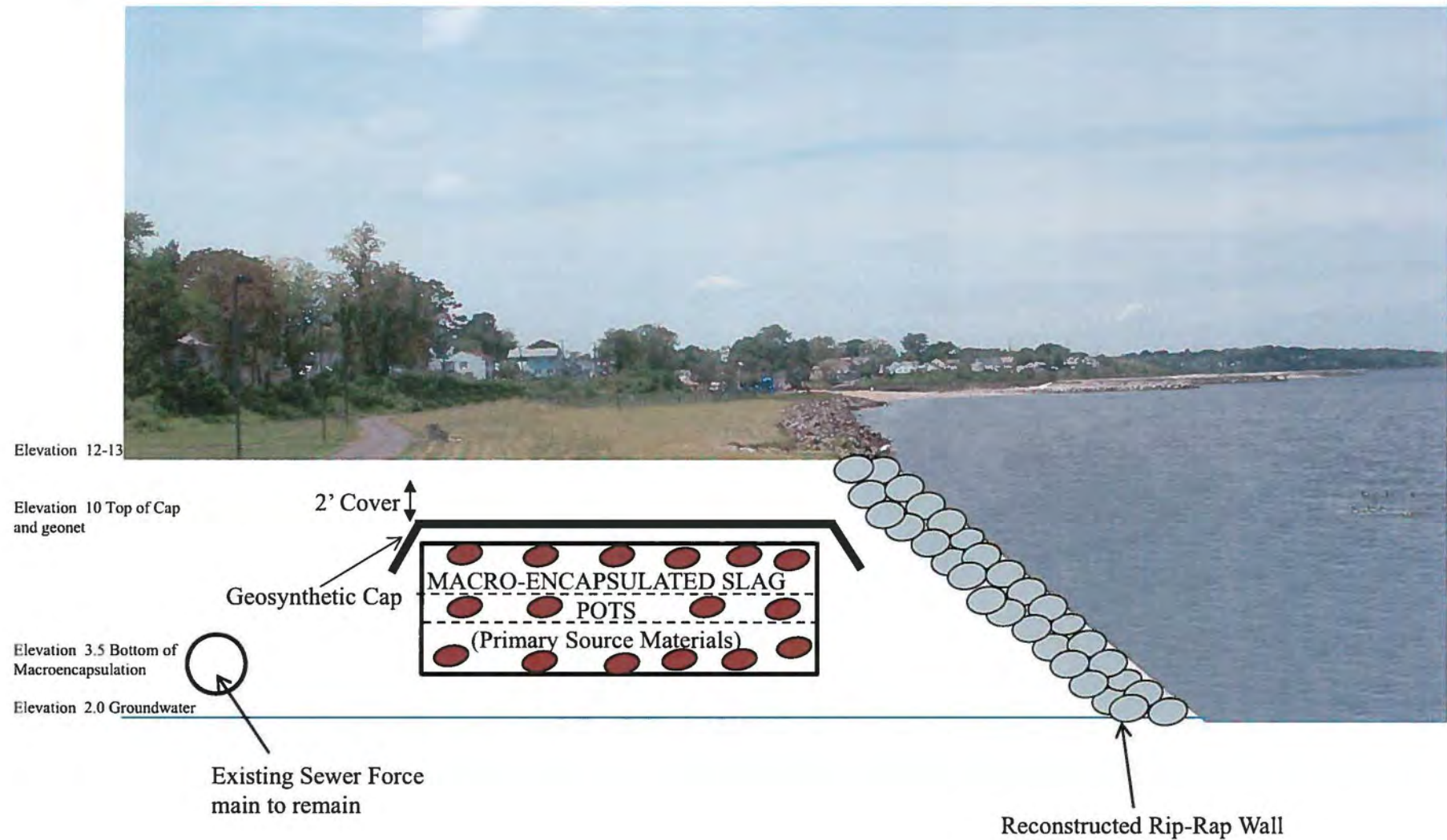




FIGURE 3-5b

Macroencapsulation Cross-Section #2

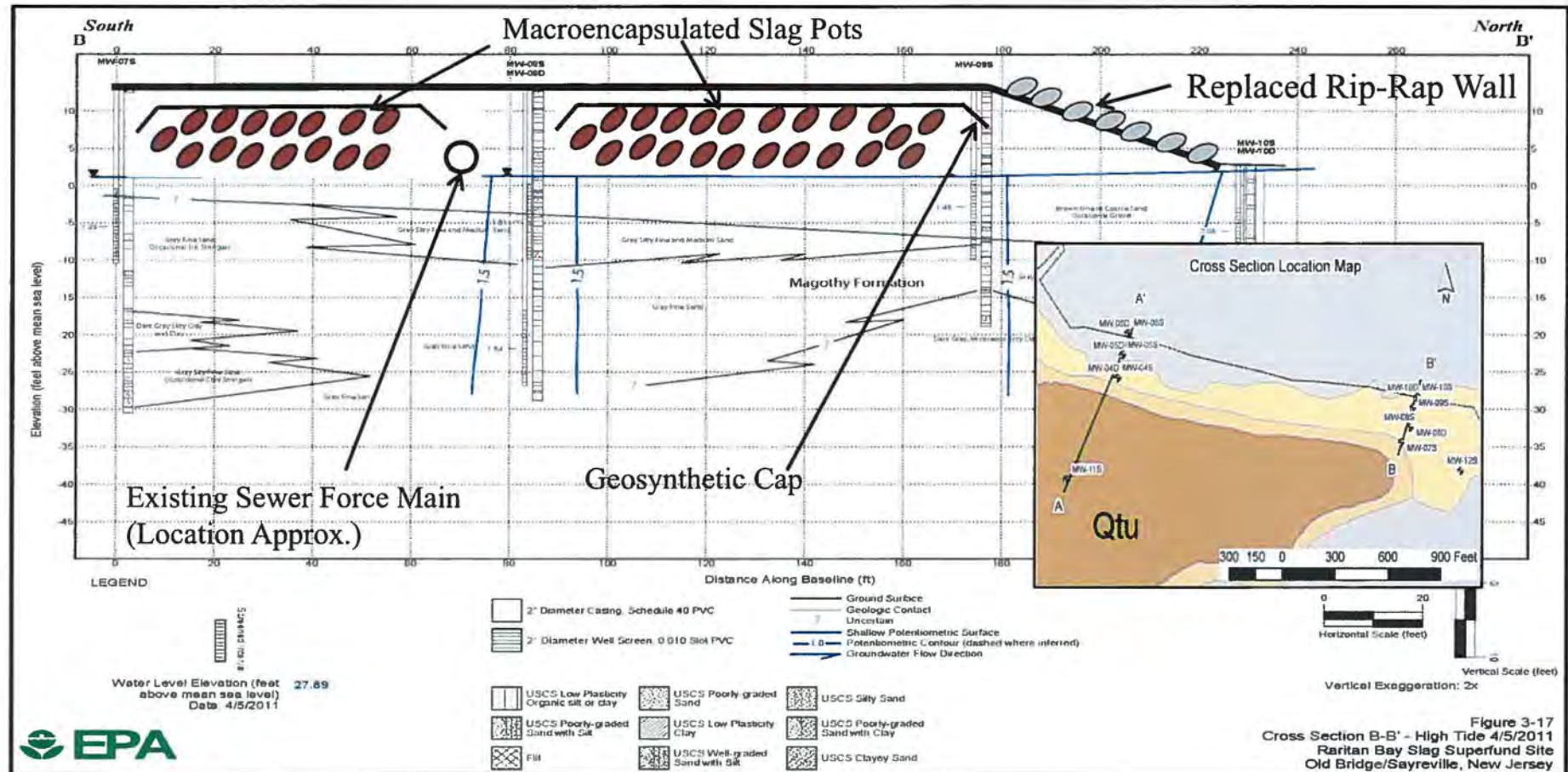




FIGURE 3-6

Permeable Upland Cap Cross-Section

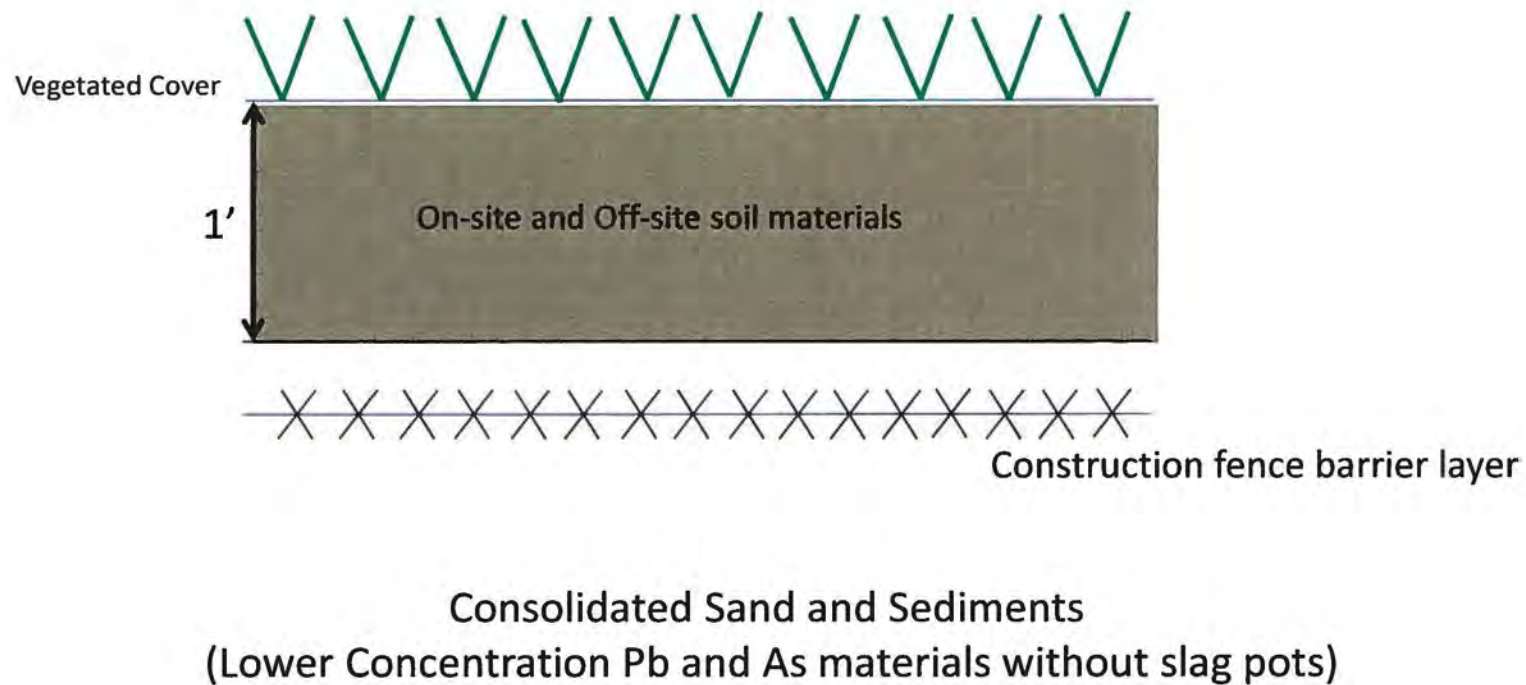
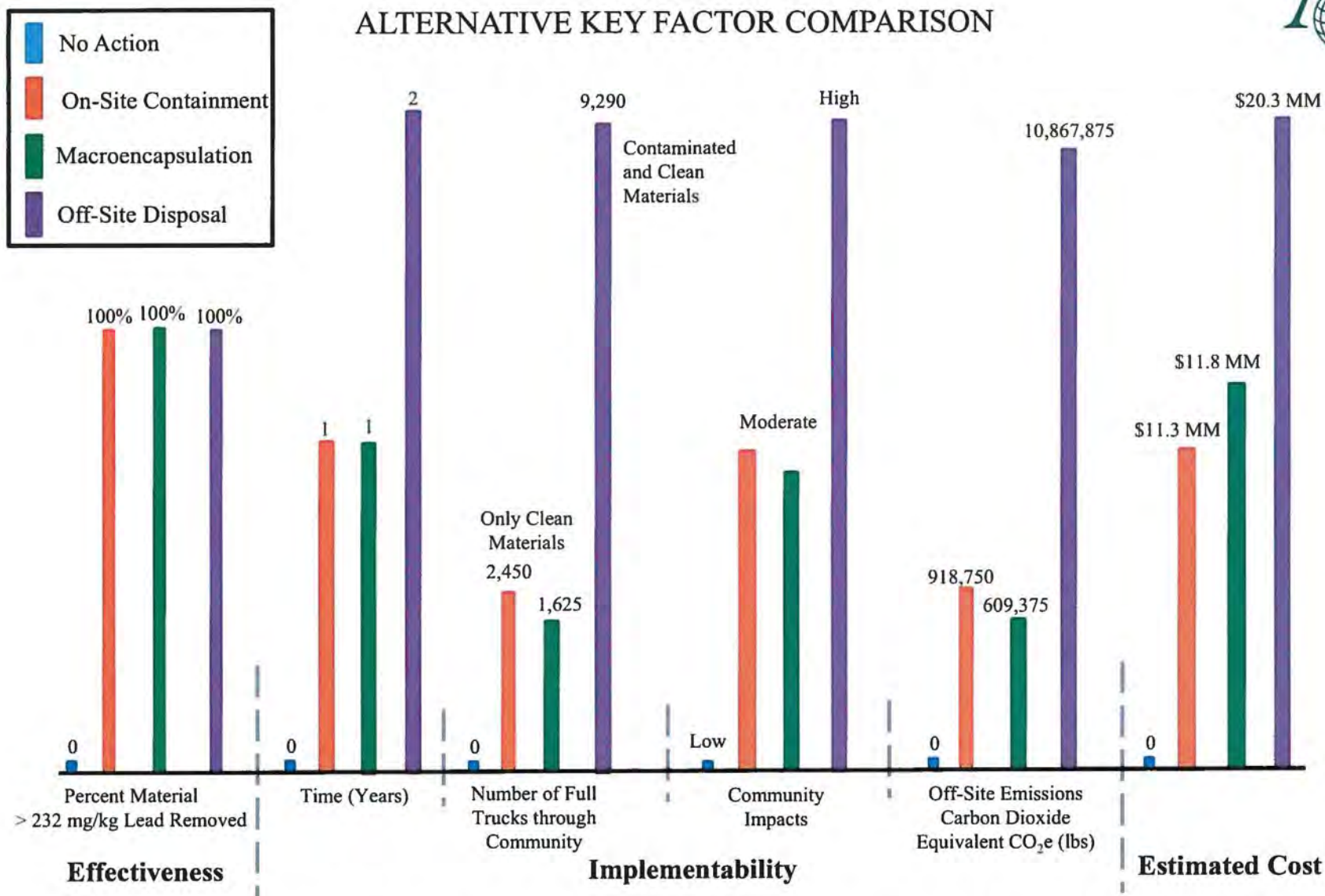




FIGURE 4-1
ALTERNATIVE KEY FACTOR COMPARISON



Community impacts include noise, dust, traffic congestion, traffic accidents and exhaust emissions.



APPENDICES



APPENDIX A

ARARs Identified in the Feasibility Study

Table 2-1
Chemical-Specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARAR	Status	Requirement Synopsis	Feasibility Study Consideration
Federal	EPA Regional Screening Level (RSL) for residential soil	To Be Considered	Establishes health-based levels for soil cleanups.	The RSL will be considered in the development of the PRGs if there are no applicable standards.
Federal	National Primary Drinking Water Standards (40 CFR 141)	Relevant and Appropriate	Establishes drinking water standards (maximum contaminant levels [MCLs]).	The standards will be used as guides to assess the effect of source removal on groundwater and surface
Federal	National Secondary Drinking Water Regulations	To Be Considered	set non-mandatory water quality standards for 15 contaminants. established only as guidance to assist public water systems in managing their drinking water for aesthetic	The RSL will be considered in the development of the PRGs.
Federal	Clean Water Act, Ambient Water Quality Criteria (40 CFR 131)	Relevant and Appropriate	Sets criteria for water quality based on protection of human health and protection of aquatic life.	The standards will be used as guides to assess the effect of source removal on groundwater and surface
State	NJDEP Residential Direct Contact and Non-residential Direct Contact Soil Remediation Standards (N.J.A.C. 7:26D)	Applicable	Establishes standards for soil cleanups.	The standards will be used to develop the PRGs.
State	NJDEP Impact to Groundwater Soil Remediation Criteria (N.J.A.C.	To Be Considered	Establishes criteria for soil cleanups.	The criteria will be considered in developing the PRGs.
State	New Jersey Ground Water Quality Standards (NJGQS) Class IIA (NJAC 7:9C)	Applicable	Establish the water quality standards for State's ground waters based on the type of groundwater use.	The standards will be used to develop the PRGs.
State	New Jersey MCLs, February 2005	Relevant and Appropriate	Establish the drinking water standards for the State.	The standards will be used to develop the PRGs.
State	New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B)	Applicable	Establishes classification of surface waters of the state, procedures for establishing water quality-based effluent limitations, and modification of water quality-based effluent limitations.	The standards will be used to develop the PRGs.

NL-RBS 000225

Table 2-2
Location-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Coastal Zone Regulations				
Federal	Rivers and Harbors Act (33 USC 403, 33 CFR 320-330)	Applicable	This act specifies regulations for filling, altering or modifying the course, location, condition, or capacity of a navigable waterway.	This requirement will be considered during the development of alternatives.
Federal	Coastal Zone Management Act (1972) and Coastal Zone Act Reauthorization Amendments (1990) (16 USC 1451 et seq; 16 USC 6217)	Applicable	This act encourages states to develop coastal management plans to manage competing uses of and impacts to coastal resources, and to manage sources of non point pollution in coastal waters.	This requirement will be considered during the development of alternatives.
State	Tidelands Conveyances	Applicable	Tidelands grants, leases, and/or licenses are required for the use of state-owned riparian lands. These conveyances are granted by the Tidelands Resources Council.	This requirement will be considered during the development of alternatives.
State	Coastal Zone Management Program (N.J.A.C. 7:7E)	Applicable	This program establishes standards for use and development of coastal resources in coastal waters to the limit of tidal influence.	This requirement will be considered during the screening, evaluation and development of alternatives.
State	Coastal Permit Program Rules (N.J.A.C. 7:7)	Applicable	These rules govern the permit requirements for activities in coastal areas in the state of New Jersey.	This requirement will be considered during the screening, evaluation and development of alternatives.
State	Coastal Area Facility Review Act Permit (N.J.S.A. 13:19-1 et seq.)	Applicable	This requirement establishes that coastal areas should be dedicated to land uses that protect public health and are consistent with laws governing the environment.	This requirement will be considered during the development of alternatives.

NL-RBS 000226

Table 2-2
Location-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
State	Waterfront Development Upland Waterfront Permit (N.J.SA 12:5-3)	Applicable	This requirement establishes the need for permitting when constructing or developing in coastal area between mean high tide. Waterfront development activities include, but are not limited to, the construction or addition of docks, wharves, piers, bridges, pipelines, dolphins, permanent buildings, and removal or deposition of subaqueous materials (dredging or filling).	This requirement will be considered during the development of alternatives.
Wetlands and Flood Plains Standards and Regulations				
Federal	Statement on Procedures on Floodplain Management and Wetlands protection (40 CFR 6 Appendix A)	Applicable	This Statement of Procedures sets forth Agency policy and guidance for carrying out the provisions of Executive Orders 11988 and 11990.	Alternatives will take into consideration for floodplain management and wetland protection.
Federal (Non-Regulatory)	Floodplain Management (EO 11988)	Applicable	Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial values of floodplains.	The potential effects of any action will be evaluated to ensure that the planning and decision making reflect consideration of flood hazards and floodplains management, including restoration and preservation of natural undeveloped floodplains.
Federal	Policy on Floodplains and Wetland Assessments for CERCLA Actions (OSWER Directive 9280.0-12, 1985)	To Be Considered	Superfund actions must meet the substantive requirements of E.O. 11988, E.O. 11990, and 40 CFR part 6, Appendix A.	Alternatives will take into consideration floodplain management and wetland protection.

NL-RBS 000227

Table 2-2
Location-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Federal (Non-Regulatory)	Wetlands Executive Order (EO 11990)	Applicable	Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance natural and beneficial values of wetlands.	Remedial alternatives that involve construction must include all practicable means of minimizing harm to wetlands. Wetlands protection considerations must be incorporated into the planning and decision making of remedial alternatives.
Federal	National Environmental Policy Act (NEPA) (42 USC 4321; 40 CFR 1500 to 1508)	To Be Considered	This requirement sets forth EPA policy for carrying out the provisions of the Wetlands Executive Order (EO 11990) and Floodplain Executive Order (EO 11988).	This requirement will be considered during the development of alternatives.
Federal	Clean Water Act (CWA) Section 404 (40 CFR parts 230 to 233)	Applicable	Under this requirement, no activity that adversely affects a wetland is permitted if a practicable alternative that does not affect wetlands is available. If no other practicable alternative exists, impacts on wetlands must be mitigated.	The effects on wetlands will be evaluated during the identification, screening, and evaluation of alternatives. Permits may be required for some alternatives.
State	Freshwater Wetland Protection Act (N.J.A.C. 7:7A, N.J.S.A.13:98-1)	Applicable	This act establishes permitting requirements for regulated activity disturbing wetlands.	This requirement will be considered during the screening, evaluation and development of alternatives.
State	Wetlands Permit (N.J.SA 13:9A-1)	Applicable	This act restricts work type and mitigative measures necessary within a wetland.	This requirement will be considered during the screening, evaluation and development of alternatives.
State	Flood Hazard Control Act (N.J.A.C.7:13)	Applicable	This act establishes state standards for activities within floodplains.	This requirement will be considered during the development of alternatives.
State	Flood Control Facilities Act (N.J.S.A 58:16A-50 et seq.; N.J.A.C. 7:8-3.15)	Applicable	This requirement sets standards to construct, operate, or acquire a flood control device.	This requirement will be considered during the development of alternatives.

NL-RBS 000228

Table 2-2
Location-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Wildlife Habitat Protection Standards and Regulations				
Federal	Endangered Species Act (16 USC 1531 et seq.; 40 CFR 400)	Applicable	This requirement establishes standards for the protection of threatened and endangered species.	This requirement will be considered during the development of alternatives.
Federal	Fish and Wildlife Conservation Act (16 USC 2901 et seq.)	To Be Considered	This act protects and conserves nongame fish and wildlife.	This requirement will be considered during the development of alternatives.
Federal	Fish and Wildlife Coordination Act (16 USC 661)	To Be Considered	This act maintain and coordinate wildlife conservation.	This requirement will be considered during the development of alternatives.
Federal	Migrator Bird Treat Act (MBTA, 1 U.S.C. 03 et seq.)	Applicable	The selected remedial action(s) must be carried out in a manner that avoids the taking or killing of protected migratory bird species, including individual birds or their nests or eggs.	This requirement will be considered during the development of alternatives.
Federal	Magnuson-Stevens Fishery Conservation and Management Act	Applicable	Raritan Bay is a designated Essential Fish Habitat (EFH) for one or more species, which may require an EFH assessment.	If there are no substantial impacts to EFH from any future proposed remedy, the site contractor may only need to complete and submit an EFH worksheet. However, if there are potential significant impacts to the EFH from project activities, the site contractor will have to prepare an EFH assessment.

NL-RBS 000229

Table 2-2
Location-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, NJ

Regulatory Level	ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
State	New Jersey Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A-1 - 15)	Applicable	This act protects and conserves endangered and nongame species.	No threatened or endangered species were observed onsite during site ecological reconnaissance.
State	New Jersey Endangered Plant Species List Act (N.J.A.C. 7:5B)	Applicable	This act protects endangered plant species.	The effects on endangered plant species will be evaluated during the identification, screening, and evaluation of alternatives.
Cultural Resources, Historic Preservation Standards and Regulations				
Federal	National Historic Preservation Act (40 CFR 6.301)	Applicable	This requirement establishes procedures to provide for preservation of historical and archeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	The effects on historical and archeological data will be evaluated during the identification, screening, and evaluation of alternatives.

Table 2-3
Action-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Principal Threat Waste			
A Guide to Principal Threat and Low Level Threat Wastes (OSWER 9380.3-06FS)	To be Considered	This guidance outlines considerations for Sites that involve significant amount of hazardous wastes that act as source of contamination for other media such as surface water and groundwater	The guidance recommends treatment of principal threat wastes. However, since treatment may not be entirely effective at the Site, any source material at the Site will be removed from existing locations.
General Site Remediation			
National Contingency Plan (40 CFR300, Subpart E)	Applicable	This regulation outlines procedures for remedial actions and for planning and implementing off-site removal actions	This standard will be applied to any investigative, planning or other remediation activities performed at the site.
OSHA Recording and Reporting Occupational Injuries and Illnesses (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the companies contracted to implement the remedy. All applicable requirements will be met.
OSHA Occupational Safety and Health Standards (29 CFR 1910)	Applicable	These regulations specify an 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below the 8-hour time-weighted average at these specified concentrations.
OSHA Safety and Health Regulations for Construction (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on site, and appropriate procedures will be followed during remediation activities.
RCRA Identification and Listing of Hazardous Wastes (40 CFR 261)	Applicable	This regulation describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation is applicable to the identification of hazardous wastes that are generated, treated, stored, or disposed during remedial activities.
RCRA Standards Applicable to Generators of Hazardous Wastes (40 CFR 262)	Applicable	Describes standards applicable to generators of hazardous wastes.	Standards will be followed if any hazardous wastes are generated onsite.
RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – General Facility Standards (40 CFR 264.10-264.101)	Relevant and Appropriate	This regulation lists general facility requirements including general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.

NL-RBS 000231

Table 2-3
Action-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Preparedness and Prevention (40 CFR 264.30–264.37)	Relevant and Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Contingency Plan and Emergency Procedures (40 CFR	Relevant and Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Emergency Procedure Plans will be developed and implemented during remedial action. Copies of the plans will be kept on site.
New Jersey Technical Requirements for Site Remediation (N.J.A.C. 7:26E)	Applicable	This regulation provides the minimal technical requirements to investigate and remediate contamination at the site.	The regulation will be applied to any hazardous waste operation during remediation of the site.
New Jersey Uniform Construction Code (N.J.A.C. 5:23)	Applicable	This code provides the requirement for construction performed during remediation of the site.	This code will be applied to any construction performed during remediation of the site.
New Jersey Hazardous Waste Regulations - Identification and Listing of Hazardous Waste (N.J.A.C. 7:26G-5)	Applicable	This regulation describes methods for identifying hazardous wastes and lists known hazardous wastes.	This regulation will be applicable to the identification of hazardous wastes that are generated, treated, stored, or disposed during remedial activities.
New Jersey Soil Erosion and Sediment Control Act (N.J.A.C. 2:90)	Applicable	This act outlines the requirements for soil erosion and sediment control measures.	This act will be considered during the development of alternatives.
Freehold Soil Conservation District Soil Erosion and Sediment Control (SESC) Plan Certification	Applicable	A SESC plan certification is required by the local soil conservation office for any project that disturbs more than 5,000 square feet of surface area of land.	The requirement will be considered during the development of the alternatives.
New Jersey Bureau of Water Allocation Temporary Dewatering Permit equivalency (N.J.A.C. 7:19)	Applicable	A temporary dewatering permit for containment cell construction will be required for the withdrawal of ground and/or surface water in excess of 100,000 gallons of water per day for a period of more than 30 days in a consecutive 365 day period, for purposes other than agriculture, aquaculture or horticulture. For dewatering in excess of 100,000 gallons of water per day, the project owner must obtain a Temporary Dewatering Allocation Permit, or Dewatering Permit-by-Rule or Short Term Permit-by-Rule depending on the duration of construction and the method employed.	The requirement will be considered during the development of the alternatives.

NL-RBS 000232

Table 2-3
Action-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
New Jersey Noise Control (N.J.A.C. 7:29)	Applicable	This standard provides the requirement for noise control.	This standard will be applied to any remediation activities performed at the site.
Waste Transportation			
Department of Transportation (DOT) Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171, 172, 177 to 179)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting hazardous materials.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
RCRA Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)	Applicable	Establishes standards for hazardous waste transporters.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
New Jersey Transportation of Hazardous Materials (N.J.A.C. 16:49)	Applicable	Establishes record keeping requirements and standards related to the manifest system for hazardous wastes.	Any company contracted to transport hazardous material from the site will be required to comply with this regulation.
Waste Disposal			
RCRA Land Disposal Restrictions (40 CFR 268)	Applicable	This regulation identifies hazardous wastes restricted for land disposal and provides treatment standards for land disposal.	Hazardous wastes will be treated to meet disposal requirements.
RCRA Hazardous Waste Permit Program (40 CFR 270)	Applicable	This regulation establishes provisions covering basic EPA permitting requirements.	All permitting requirements of EPA must be complied with.
Area of Contamination (55FR 8758-8760, March 8, 1990)	Applicable	These regulations establish rules for consolidation of contiguous waste within an Area of Concern.	Hazardous wastes may be consolidated and contained within a specific area based on these rules.
Corrective Action Management Units (Subpart S of 40 CFR 264.552)	Applicable	These regulations provide exceptions to LDR requirements and establish rules for consolidation and treatment of noncontiguous waste within the Site.	Hazardous wastes that are noncontiguous may be consolidated and contained within the same area at a different location.
New Jersey Land Disposal Restrictions (N.J.A.C. 7:26G-11)	Applicable	These regulations provide exceptions to LDR requirements and establish rules for consolidation of non-contiguous waste from one area to another area within the Site.	Hazardous wastes in one area of the Site may be consolidated in a different portion of the Site.
New Jersey Hazardous Waste (N.J.A.C. 7:26C)	Applicable	These regulations establish rules for the operation of hazardous waste facilities in the state of New Jersey.	All remedial activities must adhere to these regulations while handling hazardous waste during remedial operations.
Water Discharge or Subsurface Injection			

NL-RBS 000233

**Table 2-3
Action-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ**

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
National Pollutant Discharge Elimination System (NPDES) (40 CFR 100 et seq.)	Relevant and Appropriate	NPDES permit requirements for point source discharges must be met, including the NPDES Best Management Practice Program. These regulations include, but are not limited to, requirements for compliance with water quality standards, a discharge monitoring system, and records maintenance.	Project will meet NPDES permit requirements for point source discharges.
Effluent Guidelines and Standards for the Point Source Category (40 CFR 414)	Applicable	These regulations establish effluent limitations on direct discharge and indirect discharge point sources.	Project will meet the standards for the point source category.
Ambient Water Quality Criteria (40 CFR 131.36)	Applicable	Establishes toxics criteria for those states not complying with Clean Water Act section 303(c)(2)(B)	The criteria will be considered during the evaluation of discharge practices during any remedial action.
Clean Water Act (CWA) Section 404 (40CFR Parts 230-233)	Applicable	This requirement restricts discharge of dredged or fill material to wetlands or waters of the United States. Provides permitting program for situations with no other practical alternative. Additionally, when remediating the jetty and seawall, an engineering analysis will be needed before the USACE will grant a permit.	This requirement will be considered during the development of alternatives.
The New Jersey Pollutant Discharge Elimination System (N.J.A.C. 7:14A)	Applicable	This permit governs the discharge of any wastes into or adjacent to State waters that may alter the physical, chemical, or biological properties of State waters, except as authorized pursuant to a NPDES or State permit.	Project will meet NPDES permit requirements for surface discharges or groundwater discharge such as injection of reagent for in situ treatment.
Off-Gas Management			
Clean Air Act (CAA)—National Ambient Air Quality Standards (NAAQs) (40 CFR 50)	Applicable	These provide air quality standards for particulate matter, lead, NO ₂ , SO ₂ , CO, and volatile organic matter.	During excavation, treatment, and/or stabilization, air emissions will be properly controlled and monitored to comply with these standards.
Standards of Performance for New Stationary Sources (40 CFR 60)	Applicable	Set the general requirements for air quality.	During excavation, treatment, and/or stabilization, air emissions will be properly controlled and monitored to comply with these standards.
National Emission Standards for Hazardous Air Pollutants (40 CFR 61)	Applicable	These provide air quality standards for hazardous air pollutants.	During excavation, treatment, and/or stabilization, air emissions will be properly controlled and monitored to comply with these standards.

NL-RBS 000234

Table 2-3
Action-specific ARARs, Criteria, and Guidance
Raritan Bay Slag Site
Old Bridge/Sayreville, NJ

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
New Jersey Air Pollution Control Act (N.J.A.C. 7:27)	Applicable	Describes requirements and procedures for obtaining air permits and certificates; rules that govern the emission of contaminants into the ambient atmosphere.	Air-stripper emission from groundwater remediation activity is considered trivial activity and does not require application for an air permit.
New Jersey Ambient Air Quality Standards (N.J.A.C. 7:27-13)	Applicable	This standard provides the requirement for ambient air quality control.	This standard will be applied to any remediation activities performed at the site.

NL-RBS 000235





APPENDIX B

Clay Beneath Containment Cell Area

A

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THE
THE

APPENDIX B

Subsurface Conditions In Margaret's Creek Uplands

Available information from the RI was reviewed to assess the subsurface conditions in the Margaret's Creek uplands for their suitability as part of the two containment alternatives. Monitoring well MW-15S was installed in the vicinity of the proposed containment area as shown on Figure 1. The boring log for this well is attached and shows that there is 6 feet of fine sand and silt overlying a low plasticity clay. Figure 2 presents a photograph of these subsoils after excavation for the installation of sewer interceptor in 2008 that shows the fine sand (brown) and clays (dark clay).

The ground surface elevation at the well location was about 21 feet and the boring extended to a depth of 22 feet. Synoptic water level measurements indicate that the groundwater table is 5 to 12 feet below the ground surface.

The low plasticity clay is highly suitable to underlie a containment area for metal bearing wastes as they have low permeability and a high binding capacity such that if a minor amount of leaching occurred from the wastes, the dissolved metal would bind to the clay and not migrate further. The boring also describes the presence of mica flakes within the subsoils that also indicate that the likely clay mineral is illite which has a moderate cation exchange capacity. To the extent that the subsoils also contain organic carbon, this will also improve the binding capability of the soils surrounding the containment area.



Figure 1: Location of Monitoring Well 15S



Figure 2: Soils excavated from Margaret's Creek Uplands showing the purple-gray clay described on boring MW-15S which was found below overlying sands.

PROJECT: Raritan Bay Slag

LOCATION: Old Bridge, NJ

MONITORING WELL NO:

MW-15S

STARTED: 11/5/10 COMPLETED: 11/5/10
 DRILLING COMPANY: Uni-Tech Drilling
 DRILLING EQUIPMENT: CME 75
 DRILLING METHOD: HSA, 7 In. Dia. Borehole
 SAMPLING METHOD: NA
 SURFACE COMPLETION: Steel Stickup

NORTHING: 589684.08 Feet EASTING: 564823.95 Feet
 G.S. ELEVATION: 20.84 Feet M.P. ELEV: 23.51
 WATER: TOTAL DEPTH: 22.0 Feet
 LOGGED BY: P. Connelly
 HORIZONTAL DATUM: NAD83, COORD. SYS.: NJ State Plane
 VERTICAL DATUM:

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION	Stratigraphy	SAMPLER ADV. (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (feet)	WELL CONSTRUCTION (From - To Interval, feet bgs)
		OL	Organic material/topsoil, little brown medium sand, wet.				2			
		CL	Yellowish brown/orange SILTY CLAY, non-plastic, stiff, dry.				4		20	
			No Recovery.		1.4		8	0		0 - 10: Cement Bentonite Grout
							6			
5		ML	Light brown SILT, moist.				3			
		SP	Reddish yellow FINE SAND, well sorted, loose, moist.				3		15	
		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.		1.8		2	0		
			No Recovery.				3			
10		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.				2			
			No Recovery.				2		10	10 - 12: #00 Choke Sand
					1.3		4	0		
							4			
										12 - 22: #1 Sand Pack

CDM

110 Fieldcrest Avenue, 6th Floor
 Edison, NJ 08837
 Telephone: 732-225-7000
 Fax: 732-225-7851

MONITORING WELL
 CONSTRUCTION LOG

PROJECT NO. 74541

PAGE 1 OF 2

NL-RBS 000241

WHITE CHEMICAL WELL CONSTRUCTION LOG RARITAN BAY SLAG.GPJ RED.DEVL.GDT 9/11/11 REV.

PROJECT: Raritan Bay Slag

LOCATION: Old Bridge, NJ

MONITORING WELL NO:

MW-15S

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION	Stratigraphy	SAMPLER ADV. (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (feet)	WELL CONSTRUCTION (From - To Interval, feet bgs)
		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.				1			
		SC	Grayish brown CLAYEY FINE SAND, mica flakes, wet.			2	1 1 1 1	0	5	14 - 19; 2 inch diameter, 10 slot, PVC screen
20		CL	Dark gray CLAY, little light gray silt, non-plastic, dry.			1.4	2 3 2 2	0	0	
25			END OF BORING AT 22 FT. BGS. SAMPLED TO 22 FT. BGS.						-5	
30									-10	

CDM

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MONITORING WELL
CONSTRUCTION LOG

PROJECT NO. 74541

PAGE 2 OF 2

NL-RBS 000242

WHITE CHEMICAL WELL CONSTRUCTION LOG RARITAN_BAY_SLAG.GPJ RED_DEVIL.GDT 9/11/11 REV.

PROJECT: Raritan Bay Slag

LOCATION: Old Bridge, NJ

MONITORING WELL NO:

MW-15S

USEPA

STARTED: 11/5/10 COMPLETED: 11/5/10
 DRILLING COMPANY: Uni-Tech Drilling
 DRILLING EQUIPMENT: CME 75
 DRILLING METHOD: HSA, 7 In. Dia. Borehole
 SAMPLING METHOD: NA
 SURFACE COMPLETION: Steel Stickup

NORTHING: 589684.08 Feet EASTING: 564823.95 Feet
 G.S. ELEVATION: 20.84 Feet M.P. ELEV: 23.51
 WATER: TOTAL DEPTH: 22.0 Feet
 LOGGED BY: P. Connelly
 HORIZONTAL DATUM: NAD83, COORD. SYS.: NJ State Plane
 VERTICAL DATUM:

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION	Stratigraphy	SAMPLER ADV. (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (feet)	WELL CONSTRUCTION (From - To Interval, feet bgs)
		OL	Organic material/topsoil, little brown medium sand, wet.				2			
		CL	Yellowish brown/orange SILTY CLAY, non-plastic, stiff, dry.		1.4		4	0	20	0 - 10: Cement Bentonite Grout
			No Recovery.				8			
							6			
5		ML	Light brown SILT, moist.				3			
		SP	Reddish yellow FINE SAND, well sorted, loose, moist.		1.8		3	0	15	0 - 14: 2 inch diameter, schedule 40 PVC riser
		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.				2			
			No Recovery.				3			
10		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.	Overburden			2			
			No Recovery.		1.3		2	0	10	10 - 12: #00 Choke Sand
							4			
							4			12 - 22: #1 Sand Pack

CDM

110 Fieldcrest Avenue, 6th Floor
 Edison, NJ 08837
 Telephone: 732-225-7000
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MONITORING WELL
 CONSTRUCTION LOG

PROJECT NO. 74541

PAGE 1 OF 2

WHITE CHEMICAL WELL CONSTRUCTION LOG RARITAN BAY SLAG.GPJ RED DEVIL.GDT 9/11/11 REV.




NL-RBS 000243

PROJECT: Raritan Bay Slag

LOCATION: Old Bridge, NJ

MONITORING WELL NO:

MW-15S

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION	Stratigraphy	SAMPLER ADV. (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (feet)	WELL CONSTRUCTION (From - To Interval, feet bgs)
		CL	Purplish gray CLAY, little silt, non-plastic, medium stiff, dry.				1			
		SC	Grayish brown CLAYEY FINE SAND, mica flakes, wet.			2	1 1 1	0	5	14 - 19: 2 inch diameter, 10 slot, PVC screen
20		CL	Dark gray CLAY, little light gray silt, non-plastic, dry.			1.4	2 3 2 2	0	0	
25			END OF BORING AT 22 FT. BGS. SAMPLED TO 22 FT. BGS.						-5	
30									-10	

CDM

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MONITORING WELL
CONSTRUCTION LOG

PROJECT NO. 74541

PAGE 2 OF 2

NL-RBS 000244

WHITE CHEMICAL WELL CONSTRUCTION LOG RARITAN_BAY_SLAG.GPJ RED_DEVIL.GDT 9/11/11 REV.



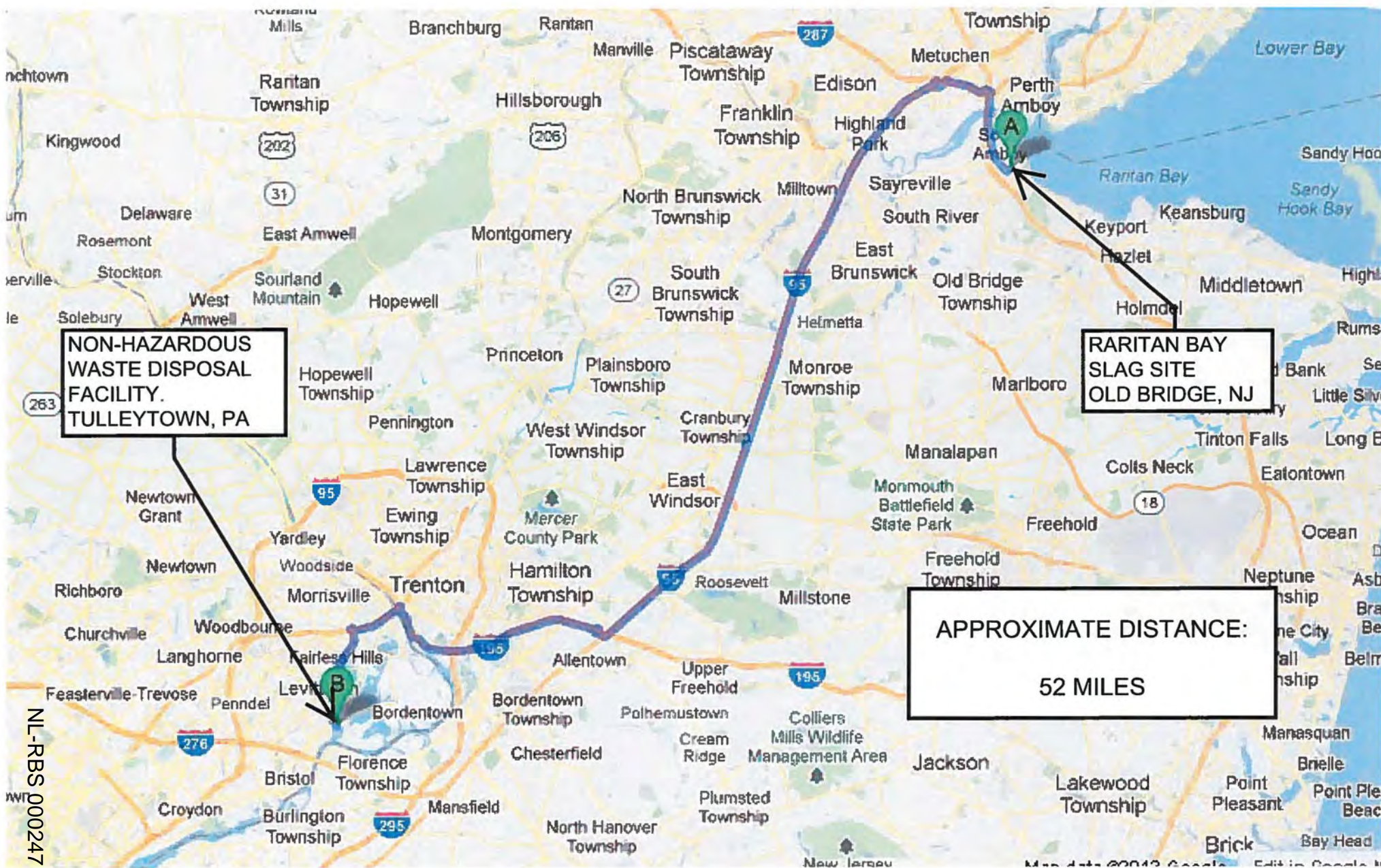
APPENDIX C

Potential Truck Routes for Off-Site Material Disposal

A

2000-01-01

2000-01-01 00:00:00 - 2000-01-01 00:00:00



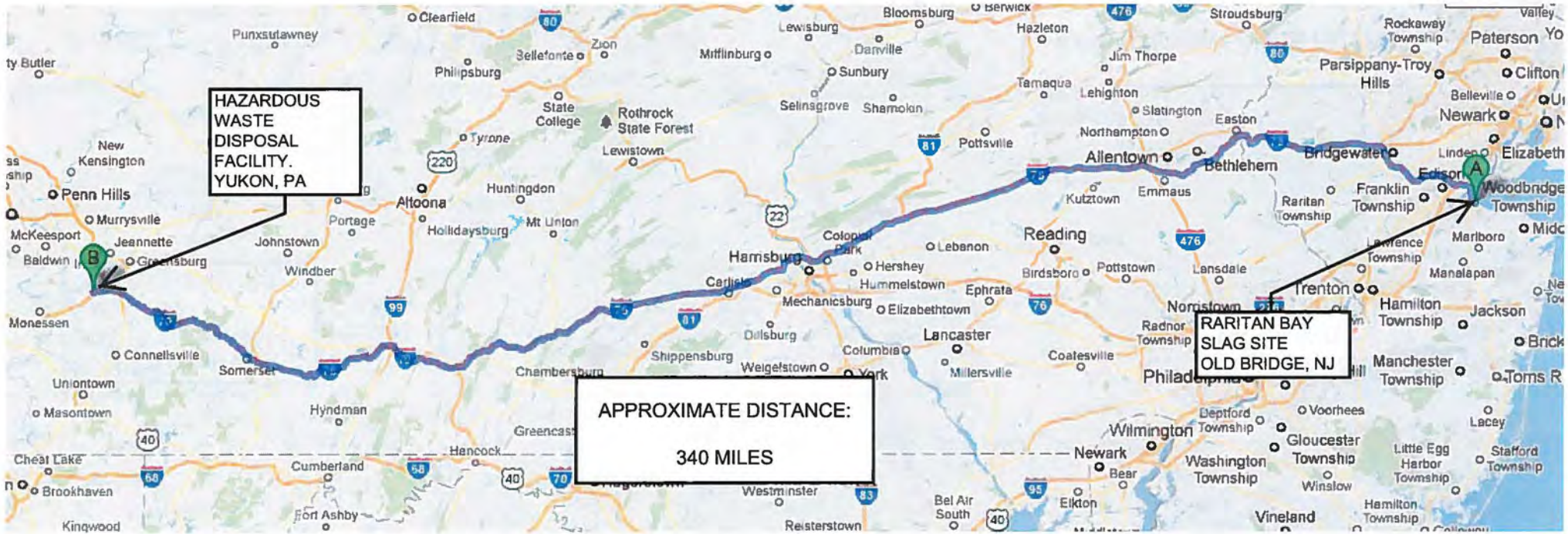
NON-HAZARDOUS
WASTE DISPOSAL
FACILITY.
TULLEYSVILLE, PA

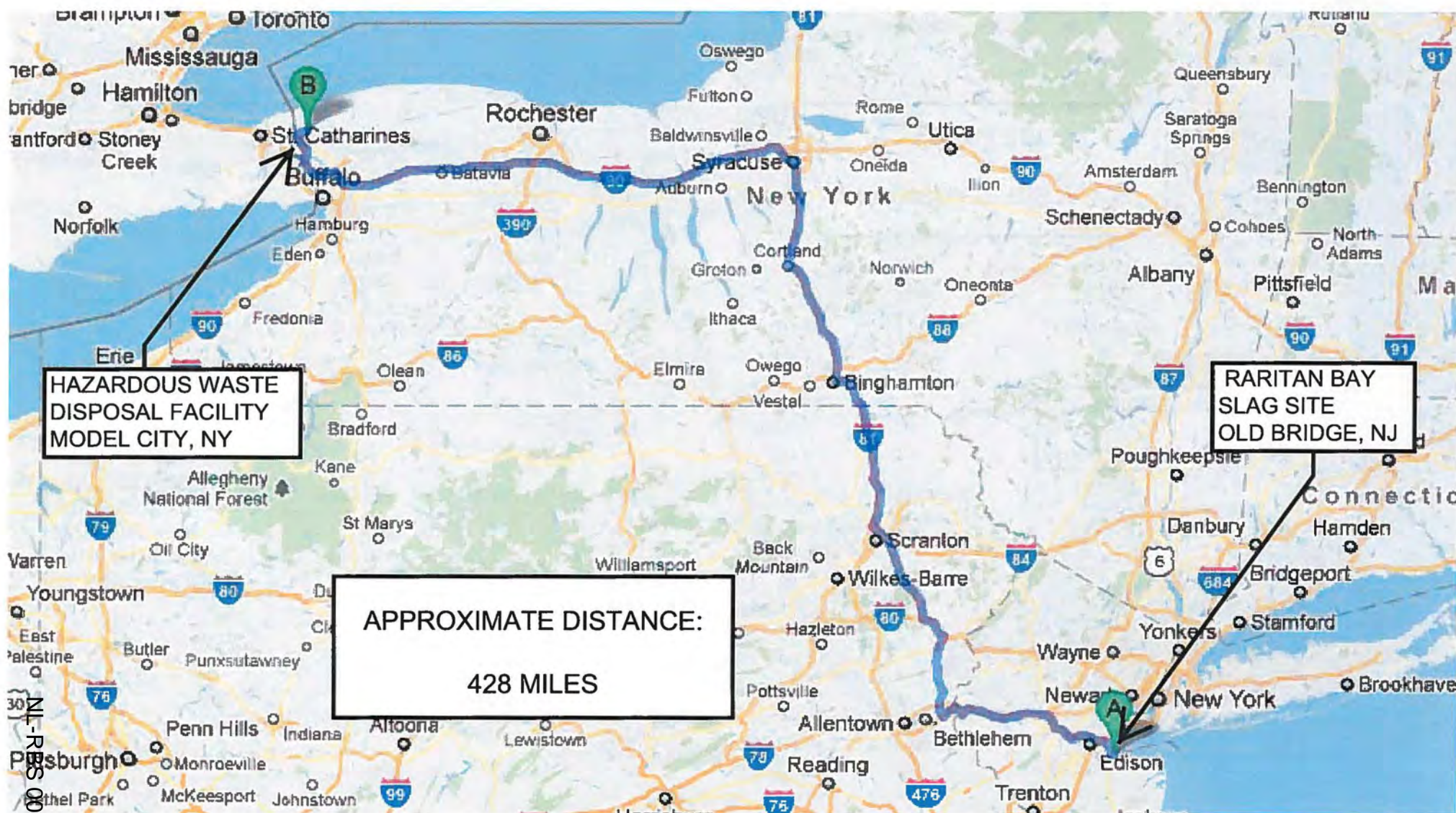
RARITAN BAY
SLAG SITE
OLD BRIDGE, NJ

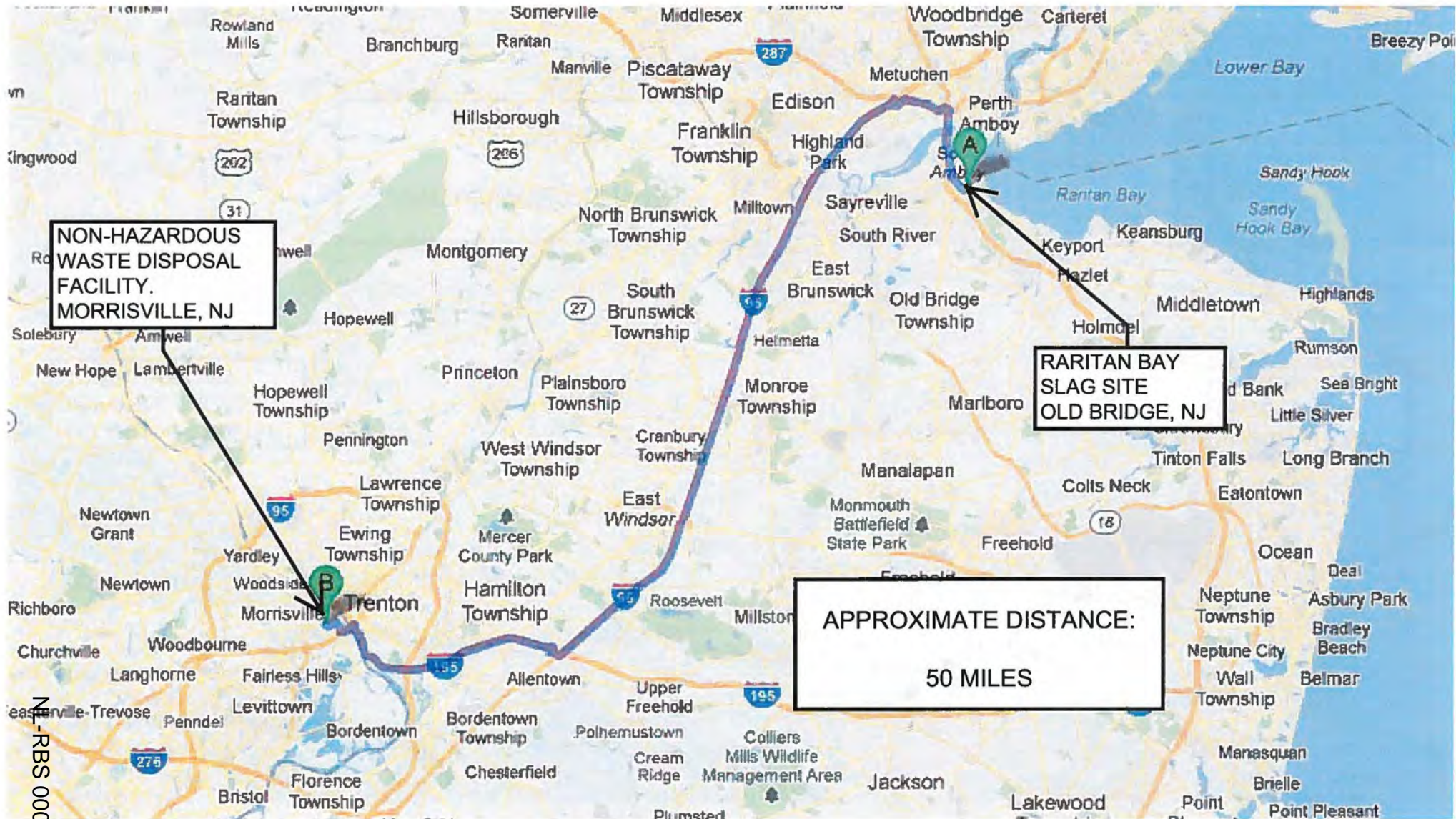
APPROXIMATE DISTANCE:
52 MILES

NL-RBS 000247

Map data ©2013 Google







RARITAN BAY AND SANDY HOOK BAY,
NEW JERSEY

LETTER
FROM
THE SECRETARY OF THE ARMY
TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED APRIL 30, 1962, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS ON A BEACH EROSION CONTROL AND INTERIM HURRICANE SURVEY OF RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY, AUTHORIZED BY THE RIVER AND HARBOR ACT APPROVED JULY 3, 1930, AS AMENDED AND SUPPLEMENTED, AND PUBLIC LAW 71, 84TH CONGRESS, APPROVED JUNE 15, 1955



JUNE 28, 1962.—Referred to the Committee on Public Works and ordered to be printed with eight illustrations

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1962

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LETTER OF TRANSMITTAL



DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C.

IN REPLY REFER TO:

June 26, 1962

Honorable John W. McCormack
Speaker of the House of Representatives

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 30 April 1962, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on a beach erosion control and interim hurricane survey of Raritan Bay and Sandy Hook Bay, New Jersey, authorized by the River and Harbor Act approved 3 July 1930, as amended and supplemented, and Public Law 71, 84th Congress, approved 15 June 1955.

In accordance with Section 1 of Public Law 534, 78th Congress, and Public Law 85-624, the views of the Governor of New Jersey and the Department of the Interior are set forth in the inclosed communications. The views of the Departments of Agriculture and Commerce, and the Public Health Service are inclosed also.

The Bureau of the Budget advises that there is no objection to the submission of the proposed report to the Congress; however, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Bureau of the Budget is inclosed.

Sincerely yours,

Elvis J. Stahr, Jr.
Elvis J. Stahr, Jr.
Secretary of the Army

1 Incl (dup)
Rept w/accomp
papers & illus

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT

BUREAU OF THE BUDGET

WASHINGTON 25, D. C.

June 14, 1962

Honorable Elvis J. Stahr, Jr.
Secretary of the Army
Washington 25, D. C.

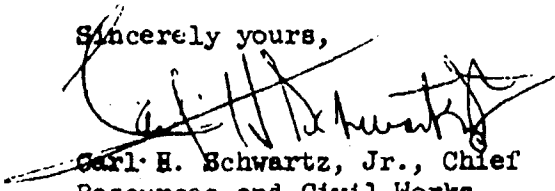
Dear Mr. Secretary:

Assistant Secretary Schaub's letter of May 8, 1962, submits the proposed review report of the Chief of Engineers on Raritan Bay and Sandy Hook, New Jersey, authorized by the River and Harbor Act approved July 3, 1930, as amended and supplemented, and Public Law 71, 84th Congress, approved June 15, 1955.

The Chief of Engineers recommends, subject to certain conditions of local cooperation, improvements along a 21-mile portion of bay shore in Middlesex and Monmouth Counties, New Jersey for the prevention of beach erosion and hurricane damages. The estimated cost of construction is \$3,097,000 to the Federal Government, and \$1,651,000 to local interests. The benefit-cost ratio is stated to be 2.2.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the proposed report to the Congress. No commitment, however, can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation.

Sincerely yours,


Carl E. Schwartz, Jr., Chief
Resources and Civil Works
Division

COMMENTS OF THE STATE OF NEW JERSEY



STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
OFFICE OF THE COMMISSIONER
TRENTON 25

April 6, 1962

Major General Keith R. Barney
Acting Chief of Engineers
U. S. Army Corps of Engineers
Washington 25, D. C.

Dear General Barney:

This will refer to your communication of 9 January 1962 concerning beach erosion control and interim hurricane survey of Raritan Bay and Sandy Hook Bay, New Jersey (Your file BNGCW-PD).

Pursuant to your suggestion the proposed report with accompanying papers has been reviewed by the various interested agencies of this department including our Division of Fish and Game. We are agreed that all items our department has had under discussion with the Corps of Engineers have been satisfactorily covered in the report. We have no further comments or recommendations to propose.

Thank you for the opportunity to make this further review before the Chief of Engineers report is transmitted to Congress by the Secretary of the Army.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "H. Mat Adams".

H. Mat Adams
Commissioner

COMMENTS OF THE DEPARTMENT OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

Lt. General Walter K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

April 5, 1962

Dear General Wilson:

As requested in your letter of January 9, we are submitting our comments on reports on Raritan Bay and Sandy Hook Bay, New Jersey. Improvements are recommended for the prevention of beach erosion and hurricane damages.

The Fish and Wildlife Service states that dredging required in the construction of the proposed project will adversely affect valuable sport and commercial fisheries in the area. The damage to these resources can be held to a minimum if the recommendations contained in the October 10, 1960 report of the Regional Director, Bureau of Sport Fisheries and Wildlife, are closely followed. It is noted that the District Engineer anticipates that, in general, these recommendations can be implemented without any significant effect on the proposed improvement or its cost. In view of the importance of the fishery resources involved, we request that if the proposed construction is undertaken, dredging plans be formulated in accordance with the recommendations of the Fish and Wildlife Service.

Other interests of the Department would not be adversely affected by the adoption of your report.

Sincerely yours,

Assistant Secretary of the Interior

COMMENTS OF THE DEPARTMENT OF AGRICULTURE



DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

April 5, 1962

Honorable Elvis J. Stahr, Jr.
Secretary of the Army

Dear Mr. Secretary:

This is in reply to the Acting Chief of Engineers' letter of January 9, 1962, transmitting for our review and comment his proposed survey report on a cooperative beach erosion control and interim hurricane survey of Raritan Bay and Sandy Hook Bay, New Jersey.

The report recommends works of improvement for shore protection in three separate reaches and for combined shore and hurricane protection in two additional reaches. The proposed improvements will not affect projects or programs of the Department of Agriculture.

Thank you for providing this report for our review.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Edward C. Crafts", is written over a horizontal line.

Edward C. Crafts
Assistant to the Assistant Secretary

COMMENTS OF THE DEPARTMENT OF COMMERCE



THE UNDER SECRETARY OF COMMERCE FOR TRANSPORTATION WASHINGTON 25

April 4, 1962

Lieutenant General W. K. Wilson, Jr., USA
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

As requested in General Barney's letter of January 9, 1962, I am transmitting herein the comments of the interested Department of Commerce agencies on your proposed report on a cooperative beach erosion control and interim hurricane survey of "Raritan Bay and Sandy Hook Bay, New Jersey."

The Coast and Geodetic Survey advises that an extensive network of primary horizontal and vertical control has been established throughout the project area and is considered adequate for the project needs. They believe that some of the existing control monuments will require relocation and ask that they be advised of the need for relocating existing monuments. The Coast and Geodetic Survey would also appreciate being advised regarding the changes that the proposed project will necessitate in the nautical charts covering the project area. They expect to issue new nautical charts covering the project area in January 1963.

The Area Redevelopment Administration wishes to bring to your attention the fact that this project is located in Monmouth County which has been designated a Redevelopment Area under Public Law 87-27. They suggest that the condition of high unemployment that exists in Monmouth County be considered in evaluating the benefit potential of this project.

The Bureau of Public Roads notes that a small amount of highway and bridge reconstruction is included in the project and that this work has been made a part of the local contribution to the project. It is necessary, therefore, to emphasize the fact that Federal-aid highway funds cannot be used in the financing of this work.

Your courtesy in providing a copy of this report for our review is appreciated.

Sincerely yours,

Frank L. Barton

Frank L. Barton
Deputy Under Secretary
for Transportation

COMMENTS OF THE PUBLIC HEALTH SERVICE



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

WASHINGTON 25, D. C.

BUREAU OF STATE SERVICES

Refer to:

April 17, 1962

Major General Walter K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

This is in reply to General Barney's letter of January 9, 1962, requesting comments on the U. S. Army Engineers' Report on the Raritan Bay and Sandy Hook Bay, New Jersey.

Comments on this project were submitted by our Regional Office in New York City to the District Engineer in August 1960. These comments are included in Appendix M of the Report. However, subsequently, as a result of a hepatitis outbreak traced to clams taken from Raritan Bay, a Conference was convened by the Department of Health, Education, and Welfare in August 1961 under the enforcement provisions of the Federal Water Pollution Control Act to examine the pollution problems in the Bay.

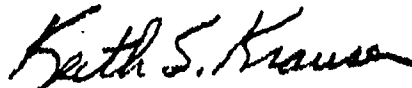
Among the subjects considered during the Conference was the effect of pollution on recreational use of the waters of the Bay. The conferees agreed that a study of the Bay would be undertaken to accumulate data on the wide range of problems influencing further control of pollution in the area. This study has been undertaken by the Public Health Service in collaboration with the New Jersey State Department of Health, the New York State Department of Health, and the Interstate Sanitation Commission.

It is expected that the data developed in the course of the study will help to provide guidelines to the local interests in the fulfillment of their obligation to control pollution to the extent necessary to safeguard the health of bathers, production of shellfish, and other uses. All interested agencies will be kept informed on the progress of these investigations.

While we do not foresee any change in our previous comments regarding the subject report, we must await the outcome of the present studies to confirm this opinion.

The opportunity to review the report is appreciated. We stand ready to provide further consultation concerning vector control, water supply and pollution control aspects of the project on your request.

Sincerely yours,

A handwritten signature in cursive script, reading "Keith S. Krause".

Keith S. Krause
Chief, Technical Services Branch
Division of Water Supply and
Pollution Control

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY



IN REPLY REFER TO

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

ENG CW-PD

30 April 1962

SUBJECT: Raritan Bay and Sandy Hook Bay, New Jersey

TO: THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report, with accompanying papers, on a survey of parts of the south shore of Raritan Bay and Sandy Hook Bay, New Jersey, in the interest of beach and hurricane protection, authorized by:

(a) Section 2 of Public Law 520, Seventy-first Congress, approved July 3, 1930, as amended and supplemented, pertaining to cooperative beach erosion control investigations; and

(b) Public Law 71, Eighty-fourth Congress, first session, approved June 15, 1955, pertaining to hurricane investigations of the eastern and southern seaboard of the United States.

2. The part of the investigation and report on beach erosion control, which was performed in cooperation with the State of New Jersey by agreement dated 25 June 1955, is complete. The hurricane portion is an interim investigation and report confined to certain areas along the south shores of the bays affected by abnormal tides. Reports on hurricane protection for several areas along the eastern and southern seaboard of the United States have been submitted previously and others, including the remaining areas along Raritan Bay and Sandy Hook Bay, will be submitted later.

3. The reporting officers find that hurricane and shore losses are severe along the 21-mile reach of the bays and that improvements can be justified in three separate reaches for shore protection, and in two separate reaches for combined shore and hurricane protection. Based on May 1960 prices, they estimate the total cost of the work at \$5,031,000, consisting of \$4,853,000 for construction, \$131,000 for lands, easements, rights-of-way, and relocations, and \$47,000 for preauthorization studies. The annual charges are estimated at \$254,000 and the annual benefits at \$498,000. The benefit-cost ratios vary by sectors from 1.3 to 3.7, the overall ratio being 2.0. The

non-Federal share of the first cost is estimated at \$1,776,000, consisting of \$131,000 for lands, easements, rights-of-way, and relocations, and \$1,645,000 as a cash contribution. They recommend the improvements, subject to certain conditions of local cooperation. They further recommend that local interests be reimbursed for the Federal share of the work accomplished at Keansburg in 1957 in the amount of \$28,000.

4. The Beach Erosion Board concurs in the views of the reporting officers that the plans of protection for the shores of the study area are practical for their respective purposes. However, the Board considers that the single-purpose shore protection plans providing for beach berm widths of 150 feet at elevation 5.5 feet above mean sea level and 50 feet at elevation 10 in front of bluffs are somewhat more than required in this locality, and that a berm width of 100 feet at elevation 5.5, or 25 feet at elevation 10 in front of bluffs, would be adequate. The Board further considers that groins may be needed at Keansburg for shore protection as well as for hurricane protection and that their locations, dimensions, and top elevation should be based on experience with the beach fill to the time of construction. Accordingly, the Board recommends authorization of the revised single-purpose shore protection plans, including the three groins as deferred construction, and reimbursement to local interests of the Federal share of cost of the completed work at Keansburg, with the provision that the improvements may be constructed separately or as part of the dual-purpose plans for Madison Township and Keansburg, and subject to certain conditions of local cooperation.

5. The Board of Engineers for Rivers and Harbors concurs in the views of the reporting officers and of the Beach Erosion Board relative to the practicability of combining the two purposes in a single plan in the applicable reaches. However, the Board considers that the provision of a 50-foot crown for the hurricane protection work is more than is needed in this area and that a 25-foot crown is adequate. It agrees with the Beach Erosion Board on the desirability of groins at Keansburg serving both purposes when their need is indicated. The Board recommends authorization of the combined hurricane and shore protection plans, with revised crown and berm widths, for Madison Township, Keansburg, and East Keansburg, subject to certain conditions of local cooperation.

6. Based on the separate findings of the two Boards, Table 1 hereof presents revised costs, benefits, and justification of the plans for the revised cross-sectional dimensions, as applicable to each segment of the shore for which improvement is proposed.

TABLE 1
PLAN OF IMPROVEMENT - RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
(Costs are in thousands of dollars, May 1960 prices)

Segement	:	:	Costs									:	:				
			Purpose:	Preauthor-:	Construction			Annual charges			Annual:			Benefit-			
					and :	ization :	Non-Federal:		Non-:						bene-:	cost	
							type(1):	studies :	Federal:	Cost :							% :
<u>Madison Township</u>	:	:	:	:	:	:	:	:	:	:	:	:	:				
Morgan Beach	:	A	:	3.0	:	179.0:	87.0:	32.7:	266.0:	6.6	:	5.2	:	11.8:	18.5	:	1.6
Thence to cabin colony	:	B	:	1.0	:	43.0:	85.0:	66.5:	128.0:	1.6	:	6.0	:	7.6:	23.1	:	3.0
Laurence Harbor cabin colony	:	A	:	3.0	:	197.0:	94.0:	32.3:	291.0:	7.2	:	6.6	:	13.8:	28.0	:	2.0
Seidler's Beach	:	C	:	1.0	:	13.0:	27.0:	67.5:	40.0:	0.5	:	3.0	:	3.5:	18.9	:	5.4
Knollcroft	:	B	:	1.0	:	3.0:	16.0:	84.2:	19.0:	0.1	:	1.5	:	1.6:	3.7	:	2.3
Thence to Whale Creek	:	C	:	1.0	:	5.0:	14.0:	73.7:	19.0:	0.2	:	1.6	:	1.8:	2.6	:	1.4
Subtotal	:	:	:	10.0	:	440.0:	323.0:	42.4:	763.0:	16.2	:	23.9	:	40.1:	94.8	:	2.4
<u>Matawan Township</u>	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Cliffwood Beach cabin colony	:	C	:	1.0	:	23.0:	53.0:	69.8:	76.0:	0.8	:	6.3	:	7.1:	32.3	:	4.5
Thence to Matawan Point	:	B	:	1.0	:	10.0:	43.0:	81.2:	53.0:	0.4	:	4.0	:	4.4:	6.1	:	1.4
Subtotal	:	:	:	2.0	:	33.0:	96.0:	74.4:	129.0:	1.2	:	10.3	:	11.5:	38.4	:	3.3
<u>Borough of Union Beach</u>	:	C	:	2.0	:	16.0:	90.0:	85.0:	106.0:	0.6	:	7.4	:	8.0:	9.5	:	1.2
<u>Borough of Keansburg and East Keansburg</u>	:	A	:	35.0	:	2,551.0:	1,142.0:	30.9:	3,693.0:	93.4	:	91.2	:	184.6:	396.1	:	2.1
TOTAL	:	:	:	49.0	:	3,040.0:	1,651.0:	35.2:	4,691.0:	111.4	:	132.8	:	244.2:	538.8	:	2.2

- (1) Type A: Dredged fill with crown 25 feet wide at elevation 15 feet above mean sea level for hurricane and beach protection, including tie-back levees for hurricane protection.
 Type B: Dredged fill with beach berm 25 feet wide at elevation 10 feet in front of bluffs for beach protection.
 Type C: Dredged fill with beach berm 100 feet wide at elevation 5.5 feet for beach protection.

7. It is noted that the reporting officers recommend reimbursement to local interests for the Federal share of work accomplished at the Borough of Keansburg in the amount of \$28,000, based on the Federal share of costs allocated to beach protection in a combined hurricane and beach protection plan. Since the work was accomplished prior to development of plans for hurricane protection, it is considered proper to compute the Federal share on the basis of single-stage beach protection. Accordingly, the amount to be reimbursed for work accomplished, including advance nourishment, is \$57,000.

8. After due consideration of these reports, I concur generally in the views and recommendations of the Beach Erosion Board and the Board of Engineers for Rivers and Harbors. I therefore recommend improvements for the prevention of beach erosion and hurricane damages along the south shore of Raritan and Sandy Hook Bays, New Jersey, to provide for:

a. Construction of the various segments within the limits given in the report of the District Engineer and shown on Plate 13 thereof, to the cross-sectional dimensions and for the purposes indicated in Table 1 hereof; and

b. Accomplishment of the foregoing generally in accordance with the plan of the District Engineer, except as noted herein, with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of \$3,040,000 for construction; provided that, prior to initiation of construction, local interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

(2) Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

(3) Bear the percentage of total first cost for each segment as shown in Table 1, to consist of the items listed in (1) and (2) above and a cash contribution to be paid either in a lump sum prior to initiation of construction or in installments prior to commencement of pertinent items, in accordance with construction

schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

(4) Hold and save the United States free from damages due to the construction works;

(5) Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

(6) Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participation is based;

(7) Control water pollution to the extent necessary to safeguard the health of bathers;

(8) Obtain approval of the Chief of Engineers of detailed plans and specifications for the work contemplated and arrangements for its prosecution, prior to commencement of any work on the recommended beach-protection phase of the project at Matawan Township and Borough of Union Beach or the beach-protection phase of the project at Madison Township for which Federal participation is planned, if undertaken separately from the recommended combined improvement;

(9) Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms; and

(10) At least annually inform interests affected that the hurricane improvements will not provide substantial protection from bay surges higher in elevation than that of hurricane "Donna", 12 September 1960.

9. I further recommend that local interests be reimbursed in the amount of \$57,000 as the Federal share of the costs incurred by them in accomplishing the beach protection work at Keansburg in 1957. The total cost to the United States for construction thus becomes \$3,097,000.



W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

ENGBR(30 Nov 60)

2nd Ind

SUBJECT: Raritan Bay and Sandy Hook Bay, New Jersey

Board of Engineers for Rivers and Harbors, Washington 25, D. C.
13 November 1961

TO: Chief of Engineers, Department of the Army

1. The study area consists of about 21 miles of bay shore and contiguous lands, subject to flooding by storm surges in the bays, in Middlesex and Monmouth Counties, New Jersey. Raritan Bay, on the west, and Sandy Hook Bay, on the east, adjoin lower New York Bay on the north. Staten Island forms the north shore of these waters and Sandy Hook, New Jersey, a low-lying peninsula on the east, separates the Atlantic Ocean from Sandy Hook Bay. Access to the bays from the ocean is through the 6-mile opening between Sandy Hook and Rockaway Point on Long Island. Hydrography off the south shore is mostly flat and shallow, the 12-foot, low-water depth generally being over a mile offshore, except for greater depths in the easterly part. The adjacent terrain consists of high bluffs interspersed with low marshlands through which a number of tidal creeks enter the bays. Beaches generally are comparatively narrow. The mean tidal range along the shore varies from 5 feet at South Amboy on the west to 3.8 feet at Highlands on the east.

2. Several incorporated communities and a number of unincorporated ones are in the study area. Development of the shore is primarily residential and recreational in character with some commerce and industry. The permanent population in 1960 was 142,000, which is greatly increased during the summer by vacationists. The 1960 value of lands and improvements in the locality is estimated at \$583 million, of which \$50 million is in the area inundated by the highest tidal surge of record, hurricane "Donna" in September 1960. About 23 percent of the shore in the study area is publicly owned.

3. There are no existing or authorized Federal projects for hurricane or beach protection in the area. Federal works affecting these purposes consist of several navigation channels in the bays, jetties at the mouth of Cheesequake Creek, a 4,000-foot breakwater at Atlantic Highlands, deposition of spoil from maintenance dredging of navigation channels on the beaches, and the channels, piers, and shore installations at the United States Navy depot at Leonardo. In addition, extensive shore-protection works have been accomplished by local interests with funds provided by the Works Progress Administration. Since 1929, the State of New Jersey, the municipalities, and

private interests have constructed numerous bulkheads and groins, and have deposited large quantities of dredged fill on the beaches, at a cost of several million dollars, in an effort to preserve the beaches and protect property. In 1957, the State placed about 438,000 cubic yards of material from the bay along 6,000 feet of shore at Keansburg at a total cost of \$194,000. In some cases these works are serving their purpose, but the majority have accomplished little improvement for various reasons. Because of pollution in the bays, local interests have constructed, since 1928, waste-treatment works at a cost of about \$35 million and are planning additional works in the area. These facilities have reduced the pollution to the extent that the Interstate Sanitary Commission of New Jersey, New York, and Connecticut has recently classified the waters as suitable for recreation, shellfish culture, and development of fish life.

4. The shore of the study area is generally protected from waves of the Atlantic Ocean by the Sandy Hook peninsula. However, available information indicates that, although ocean waves entering the bays are modified in height and direction by refraction and shoaling, waves as high as 14 feet are possible off Point Comfort in Keansburg, New Jersey. Storm wave heights of about 5 feet have been reported at Atlantic Highlands. The predominant energy components produce a weak westward littoral transport, except near the east end of the area. Intermittent surveys of the shore and offshore depths, since 1836, indicate a net accumulating loss of beaches of about 1 to 2 cubic yards per linear foot of beach per year. The average value of land and improvements lost by erosion is estimated at \$12,000 annually.

5. Hurricane losses in the area result mainly from inundation caused by abnormal surges in the bays, wave action, wind action, and storm-induced rainfall. The orientation and configuration of the bays result in the study area being inordinately vulnerable to inundation and wave action along the shore. Between 1635 and 1960, inclusive, 199 hurricanes and other tropical and extratropical storms have affected the area. Under existing conditions, 6 of these storms would cause unusually severe damages; 16, severe; 81, moderate; and 96 would be threats only. The high incidence of water damages suffered in the area is indicated by the fact that the maximum bay level of record caused about \$6 million damages as compared to an estimated average annual damage of \$1 million.

6. Local interests generally desire restoration of the deteriorated beaches and measures to reduce loss of life and property damage, including an adequate hurricane warning system. In addition, they request reimbursement for work done at Keansburg by the State of New Jersey subsequent to initiation of the cooperative beach erosion study. They further request that some local communities be permitted to finance the local share of costs on a long-term installment basis. They have indicated willingness to comply with the requirements of local cooperation.

7. The District Engineer finds that losses in the 21-mile section between South Amboy and Highlands are of sufficient magnitude to justify improvements for beach erosion control along three separate reaches of shore, and combined hurricane protection and beach erosion control along two separate reaches. The beach-protection plans provide for berm widths of 150 feet at elevation 5.5 feet above mean sea level and 50 feet at elevation 10 in front of bluffs. The plans for combined hurricane and beach protection provide for dikes constructed of dredged material having a crown width of 50 feet at elevation 15 with tie-back levees of lesser crown widths. Three rock groins at elevation 5.5 would be constructed at Point Comfort in Keansburg, if and when needed. The District Engineer estimates the first cost of his plan at \$5,031,000, consisting of \$4,853,000 for construction, \$131,000 for lands, easements, rights-of-way, and relocations, and \$47,000 for preauthorization study costs. He estimates the annual charges at \$254,000 and the annual benefits at \$498,000, yielding an overall benefit-cost ratio of 2.0. The benefit-cost ratios for the five separate improvements vary from 1.3 to 3.7. The District Engineer recommends adoption of his plan, subject to conditions of local cooperation. He further recommends that local interests be reimbursed in the amount of \$28,000 for a portion of the work accomplished by them at the Borough of Keansburg in 1957. The Division Engineer concurs.

8. The Division Engineer issued a public notice stating the recommendations of the reporting officers and affording interested parties an opportunity to present additional information to the Board. Many communications were received, the majority of which pertain to the need for protection from tidal flooding in the Cliffwood Beach-Keyport-Union Beach and Port Monmouth areas. These communications were referred to the reporting officers who have determined that the new information justifies re-examination of these areas, which will be the subject of a separate report at a later date. The Board has given careful consideration to the communications received.

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

9. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers relative to the plans for the area, and particularly in respect to the accomplishments and justification for inclusion of the works for hurricane protection in the Morgan Beach-Laurence Harbor area in Madison Township and the Keansburg-East Keansburg area. The Board is cognizant of the views and recommendations of the Beach Erosion Board and concurs with that Board in its view that the purposes of hurricane protection and shore protection are compatible when combined in a single plan. The Board notes that the plans for hurricane protection are based upon the maximum storm surge of record, which is significantly lower than the maximum which can be reasonably expected in the area, and believes that those affected should recognize the partial-protection nature of the plans. The Board notes that the Beach Erosion Board recommends lesser beach widths and higher groins than do the reporting officers.

10. The Board is of the opinion that the crown width of the frontline hurricane protection works need be only 25 feet in lieu of the 50 feet recommended by the reporting officers. This opinion is based upon a comparison with existing and authorized works having similar or greater degrees of exposure to surges, waves, and duration of attack along the Atlantic coast.

11. Relative to the request of local interests in some localities that they be permitted to reimburse their share of costs of the work on a long-term basis, the Board concurs with the reporting officers in the view that the State of New Jersey, the sponsor of the beach erosion study, may be willing to consider assisting those communities under such financing arrangements.

12. The reporting officers have furnished supplementary data based upon the lesser berm widths for beach protection, lesser crown width for hurricane protection, and higher groins, pertaining to costs, benefits, benefit-cost ratios, cost allocation, and cost apportionment. These data have been utilized by the Beach Erosion Board in its report and are the basis of the amounts shown in Table 1 below. The plan, as revised, is economically justified, the cost apportionment is equitable, and it is believed that local interests, who have agreed conditionally to the requirements of local cooperation, would not object to the modified design.

TABLE 1

Combined Plan for Hurricane and Beach Protection

Raritan Bay and Sandy Hook Bay, New Jersey

(Costs and benefits in thousands of dollars, May 1960 prices)

Reach and purpose	First Costs			Annual Charges			Benefit-	
	Federal	Non-Federal	Total	Federal	Non-Federal	Total	Annual benefits	cost ratio
<u>Madison Township</u>								
Hurricane protection	367.0	156.0(1)	523.0	13.4	9.2	22.6	34.8	1.5
Shore protection	9.0	25.0	34.0	0.4	2.6	3.0	11.7	3.9
Total	376.0	181.0(2)	557.0(5)	13.8	11.8(7)	25.6	46.5	1.8
<u>Keansburg and East Keansburg</u>								
Hurricane protection	2,523.0	1,081.0(3)	3,604.0	92.4	87.1	179.5	325.7	1.8
Shore protection	28.0	61.0	89.0	1.0	4.1	5.1	70.4	13.8
Total	2,551.0	1,142.0(4)	3,693.0(6)	93.4	91.2(8)	184.6	396.1	2.1

Includes cost of lands, easements, rights-of-way, and relocations of (1) \$6,000 and (3) \$125,000.

Includes cash contribution of (2) \$175,000 and (4) \$1,017,000.

Excludes preauthorization study cost of (5) \$6,000 and (6) \$35,000.

Includes cost of maintenance and beach replenishment of (7) \$5,100 and (8) \$49,900.

13. Recommendations.--The Board therefore recommends improvements for the prevention of beach erosion and hurricane damages, consisting of:

Construction of about 2,585 linear feet of beach fill with a crown 25 feet wide at elevation 15 feet above mean sea level, and about 1,940 linear feet of tie-back levee with a variable crown width at elevation 15, together with necessary interior drainage facilities and road crossings, at Morgan Beach and Laurence Harbor in Madison Township, New Jersey, at an estimated total cost for construction of \$557,000;

Construction of about 14,150 linear feet of beach fill with a crown 25 feet wide at elevation 15 feet above mean sea level, about 13,290 linear feet of tie-back levee with a variable crown width at elevation 15, and three rock groins of a suitable top elevation to be provided when experience indicates the need thereof, together with necessary interior drainage facilities and road crossings, at Keansburg and East Keansburg, New Jersey, at an estimated total cost for construction of \$3,693,000;

all generally in accordance with the plan of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; provided that, prior to construction, local interests give assurances satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

b. Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

c. Bear 32.5 percent of the total first cost of the work in Madison Township, and 30.9 percent of that at Keansburg and East Keansburg, sums presently estimated at \$181,000 and \$1,142,000, respectively, to consist of the items listed in a. and b. above, and cash contributions presently estimated at \$175,000 and \$1,017,000, respectively; such cash contributions to be paid either in a lump sum prior to initiation of construction or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

d. Hold and save the United States free from damages due to the construction works;

e. Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

f. Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participation is based;

g. Control water pollution to the extent necessary to safeguard the health of bathers;


h. Obtain approval of the Chief of Engineers of detailed plans and specifications for the work contemplated and arrangements for its prosecution, prior to commencement of any work on the recommended beach-protection phase of the project at Madison Township for which Federal participation is planned, if undertaken separately from the recommended combined improvement;

i. Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms; and

j. At least annually inform interests affected that the hurricane improvements will not provide substantial protection from bay surges higher in elevation than that of hurricane "Donna", 12 September 1960.

14. This recommendation pertains only to the plans for combined shore protection and hurricane protection in the study reach, without regard to those segments where beach protection alone is found to be justified.

FOR THE BOARD:


KEITH R. BARNEY
Major General, USA
Chairman

REPORT OF THE BEACH EROSION BOARD

CORPS OF ENGINEERS, U. S. ARMY
BEACH EROSION BOARD
WASHINGTON, D. C.

2 November 1961

SUBJECT: Cooperative Beach Erosion Control and Interim Hurricane Study of
Raritan and Sandy Hook Bays, New Jersey

TO: Chief of Engineers
Department of the Army
Washington, D. C.

1. This report of the Beach Erosion Board is on a study of erosion made in cooperation with the State of New Jersey under authority of section 2 of the River and Harbor Act approved July 3, 1930, as amended and supplemented. The purpose of the investigation was to develop the most suitable plans for restoration of the shore and protection of property against erosion along the bays' shores. In addition to single-purpose shore protection plans developed under the foregoing authority, the report submitted by the District and Division Engineers includes study of the needs and methods for protection against damages caused by hurricanes under the provisions of Public Law 71, 84th Congress, resulting in a dual-purpose plan which would provide both hurricane and shore protection. In its review of the report the Beach Erosion Board has given consideration to the technical adequacy of both plans, but has limited its consideration of project justification and Federal participation to the single-purpose shore protection plans in accordance with its statutory functions as prescribed in section 3 of Public Law 166, 79th Congress.

2. The study area, which lies in Middlesex and Monmouth Counties, comprises the 21-mile length of the shores of Raritan and Sandy Hook Bays between South Amboy and Highlands. The western end of the study area is about 30 miles by highway southwest of midtown New York City. This shore is an important summer recreational area. The permanent population of communities in the study area is over 142,000. The population is greatly increased by summer vacationists. About 23 percent of the shore in the study area is publicly owned.

3. The coastal area under study includes high bluffs near its east and west ends and low marshlands in the intervening area. Beaches generally are narrow. The bluffs supply a limited quantity of beach material and a deficiency of supply results in a slow deterioration of the protective and recreational beaches. The shore of the study area is generally protected from waves of the Atlantic Ocean by Sandy Hook. The predominance of energy components is such as to produce a dominant westward littoral transport of beach material except near the east end of the

area, but the rate of transport is generally low. The mean tidal range increases from 3.8 feet at Highlands to 5.0 feet at South Amboy. The highest estimated bay level, about 10 feet above sea level, occurred during hurricane Donna in 1960.

4. The District Engineer has considered the desires of the cooperating agency, has studied the sources and movement of beach material, the changes in the shore line and offshore bottom, the effects of waves, storms and of existing structures, and has developed plans for protecting the shore of the study area against both erosion and hurricane damages. The dual-purpose plan comprises beach fills and levees with a top elevation of 15 feet above mean sea level, and in the case of Keansburg the plan includes three groins. Alternative plans for shore protection (erosion control) alone consisting of placing beach fill to provide a berm 150 feet wide at an elevation of 5.5 feet above mean sea level, or 50 feet wide at an elevation of 10 feet in front of bluffs, were also developed. Maintenance of the stability of the shore would be accomplished by periodic replenishment of sand losses under either plan.

5. The District Engineer has made economic analyses of the foregoing plans of shore and hurricane protection. The estimated first costs and annual charges of interest, amortization and maintenance, estimated benefits and the benefit-cost ratios for the dual-purpose and single-purpose plans, based on the May 1960 price level, are as follows:

Dual-Purpose Hurricane and Shore Protection Plans

<u>Location</u>	<u>First Costs</u>	<u>Annual Costs</u>	<u>Annual Benefits</u>	<u>Benefit-Cost Ratio</u>
Madison Township	\$883,000 ⁽¹⁾ 873,000 ⁽²⁾	\$43,700	\$111,500	2.6
Keansburg and East Keansburg ⁽³⁾	4,036,000 ⁽¹⁾ 3,999,000 ⁽²⁾	195,800	396,100	2.0

(1) Including preauthorization study costs.

(2) Exclusive of preauthorization study costs.

(3) The erosion control portion of this plan for Keansburg was completed by local interests in 1957 at a cost of \$181,000, and the hurricane protection increment has therefore been considered as a single-purpose hurricane protection plan in the District Engineer's report.

Single-Purpose Shore Protection Plans

<u>Location</u>	<u>First Costs</u>	<u>Annual Costs</u>	<u>Annual Benefits</u>	<u>Benefit-Cost Ratio</u>
Madison Township	\$391,000 ⁽¹⁾ 385,000 ⁽²⁾	\$23,800	\$76,700	3.2
Matawan Township	177,000 ⁽¹⁾ 175,000 ⁽²⁾	13,200	48,800	3.7

Single-Purpose Shore Protection Plans (Cont.)

<u>Location</u>	<u>First Costs</u>	<u>Annual Costs</u>	<u>Annual Benefits</u>	<u>Benefit-Cost Ratio</u>
Union Beach	\$133,000 ⁽¹⁾ 131,000 ⁽²⁾	\$8,900	\$11,600	1.3
Keansburg ⁽³⁾	185,000 ⁽¹⁾ 181,000 ⁽²⁾	35,900	70,400	2.0
Leonardo	206,000 ⁽¹⁾ 204,000 ⁽²⁾	11,300	6,700	0.6

(1) Including preauthorization study costs.

(2) Exclusive of preauthorization study costs.

(3) Work completed in 1957 by local interests.

6. The District Engineer concludes that the hurricane and shore protection plans for Madison Township, and Keansburg and East Keansburg are amply justified by evaluated benefits, also that shore protection is justified for Matawan Township and Union Beach. He finds that public benefits justify Federal aid to first costs for shore protection under the provisions of Public Law 826, 84th Congress, and that prospective benefits justify Federal aid to hurricane protection under the policy requiring 30 percent local cooperation as approved for hurricane protection projects in the Flood Control Act of 1958 (Public Law 85-500, 85th Congress). Accordingly he recommends adoption of a project by the United States for the foregoing protection at a presently estimated first cost to the United States of \$3,236,000, including the Federal share of costs of shore protection work accomplished by local interests since initiation of the cooperative beach erosion study. The Division Engineer concurs in the recommendations of the District Engineer.

7. Local interests were informed of the findings and recommendations of the District and Division Engineers and invited to present additional information for the consideration of the Beach Erosion Board. Communications received as a result of the public notice generally expressed views on the need of hurricane protection, but furnished no additional information regarding needs for erosion control measures.

VIEWS AND RECOMMENDATIONS OF THE BEACH EROSION BOARD

8. The Board has carefully considered the reports of the reporting officers. It concurs generally in their views that the plans of protection for the shores of the study area are practical plans for their respective purposes. However, it should be noted the hurricane protection is designed for storm surges equivalent to those of record, but not for those of the maximum probable or even the standard project hurricane which might occur infrequently. Accordingly, it is imperative that local interests recognize that the plan would provide only partial hurricane protection. The Board considers that the single-purpose shore protection plans consisting of widening the beach to provide a berm 150

feet wide at an elevation of 5.5 feet above mean sea level, or 50 feet wide at an elevation of 10 feet above mean sea level in front of bluffs, are somewhat more than required in this locality, and that a berm width of 100 feet at an elevation of 5.5 feet, or 25 feet at an elevation of 10 feet in front of bluffs, would be adequate. The Board also believes that groins may be needed at Keansburg for shore protection as well as for hurricane protection, and desires to include them in the single-purpose shore protection plan for deferred construction when experience indicates their justification. Further consideration should also be given to the locations and dimensions of those groins, based on additional experience with the beach fill to the time of construction, and to a suitable top elevation for groins to be effective in retaining the fill of the hurricane barrier during periods of high water. The estimated first costs, annual charges of interest, amortization and maintenance, estimated annual benefits and the benefit-cost ratios for the single-purpose shore protection plans based on the lesser berm widths considered adequate by the Board, except in the case of the completed Keansburg beach fill where additional material placed by local interests is considered advance nourishment, are as follows:

Single-Purpose Shore Protection Plans

<u>Location</u>	<u>First Costs</u>	<u>Annual Costs</u>	<u>Annual Benefits</u>	<u>Benefit-Cost Ratio</u>
Madison Township	\$283,000 ⁽¹⁾ 277,000 ⁽²⁾	\$20,000	\$60,000	3.0
Matawan Township	131,000 ⁽¹⁾ 129,000 ⁽²⁾	11,500	38,400	3.3
Union Beach	108,000 ⁽¹⁾ 106,000 ⁽²⁾	8,000	9,500	1.2
Keansburg ⁽³⁾	360,000 ⁽¹⁾ 356,000 ⁽²⁾	46,100	70,400	1.5
Leonardo	160,000 ⁽¹⁾ 158,000 ⁽²⁾	9,700	5,700	0.6

(1) Including preauthorization study costs.

(2) Exclusive of preauthorization study costs.

(3) Includes \$181,000 for beach fill completed in 1957 by local interests and \$175,000 for 3 groins.

9. In accordance with existing statutory requirements, the Beach Erosion Board states its opinion that the public interest associated with protection of public lands and improvements and public use of the shore is sufficient to warrant adoption of projects authorizing Federal participation in the costs of protecting against erosion the shores of Madison Township, Matawan Township, Union Beach and Keansburg, the share of the

expense thereof to be borne by the United States being one-third of the costs of the work applicable to publicly owned shores, and one-third of the costs adjusted by the ratio of public to total benefits for those privately owned shores where public benefits arise, in accordance with the provisions of Public Law 826, 84th Congress. The extent of Federal participation by shore segments and estimated composite percentages based on present conditions of ownership and use are computed as follows:

Apportionment of Costs for Alternative Single-Purpose
Shore Protection Plans

<u>Item</u>	<u>Madison Township</u>	<u>Matawan Township</u>	<u>Union Beach</u>	<u>Keansburg</u>
Non-Federal public shore %	30.9	0	37.8	41.3
Private shore with public benefits %	67.3	100.0	10.0	58.7
Ratio, public to total benefits for private shores with public benefits	0.88	0.86	0.88	0.91
Federal shares of costs ⁽¹⁾	30.4	25.6	15.1	31.6
First costs ⁽²⁾	\$277,000	\$129,000	\$106,000	\$356,000 ⁽³⁾
Federal share	84,000	33,000	16,000	112,000

(1) Federal share % = $1/3$ (% public shore + % private shore with public benefits x ratio public to total benefits for private shore with public benefits).

(2) Exclusive of preauthorization study costs.

(3) Includes \$181,000 for beach fill completed in 1957 by local interests and \$175,000 for 3 groins.

10. The Beach Erosion Board recommends adoption of projects for the shores of Madison and Matawan Townships, Union Beach and Keansburg, New Jersey to authorize Federal participation in the costs of plans for protection of the shores, comprising artificial placement of beach fill to provide for a beach berm 100 feet wide at an elevation of 5.5 feet above mean sea level, or 25 feet wide at an elevation of 10 feet above mean sea level in front of bluffs, and three groins at Keansburg as deferred construction when experience indicates the need thereof, with such modifications thereof as may be considered advisable by the Chief of Engineers. The foregoing recommended plans may be constructed separately

or as part of dual-purpose plans for Madison Township and Keansburg if the latter plans are recommended by the Board of Engineers for Rivers and Harbors and subsequently authorized. Federal assistance in the single-purpose shore protection plans would entail contribution of funds presently estimated to amount to the percentages of the initial construction costs of the beach widening in the four sections as indicated in the preceding paragraph. Initial costs as presently estimated total \$868,000 (including cost of completed beach fill at Keansburg) for the beach fill and groins, with the total Federal share presently estimated at \$245,000.

11. Federal participation is recommended subject to the condition that responsible local authorities will:

a. Obtain approval by the Chief of Engineers, prior to commencement of work on a project of detailed plans and specifications and arrangements for prosecution of the work on that project, except for the completed beach fill at Keansburg;


b. Furnish assurances satisfactory to the Secretary of the Army that they will:

(1) Maintain the projects and provide nourishment of the protective beaches at suitable intervals during their economic life as may be required to serve their intended purpose;

(2) Control water pollution to the extent necessary to safeguard the health of bathers; and

(3) Maintain during the economic life of the projects continued public ownership of the publicly owned shores and continued availability for public use of the privately owned shores upon which the recommended Federal participation is based.

FOR THE BOARD:


KEITH R. BARNEY
Major General, USA
President

At the time of adoption of this report the members of the Beach Erosion Board were:

Major General Keith R. Barney, President
Dr. Thorndike Saville, State of New York
Dean Morrrough P. O'Brien, State of California
Dr. Lorenz G. Straub, State of Minnesota
Brigadier General Thomas H. Lipscomb, U. S. Army
Brigadier General Howard A. Morris, U. S. Army
Brigadier General Arthur H. Frye, Jr., U. S. Army

REPORT OF THE DISTRICT ENGINEER

S Y L L A B U S

The purpose of this beach erosion control and interim hurricane study is to develop most suitable plans for restoration of the shore and protection of property against erosion along Raritan and Sandy Hook Bays, N. J., and to develop an adequate plan of protection against tidal flooding in areas initially selected for detailed study.

The District Engineer finds that the shore at a number of locations in the study area has been seriously eroded by wave action. This has exposed public and private properties to damage from wave attack and has reduced the width of beaches to the extent that they are inadequate for recreational use. Because of the especially low and flat terrain, several areas are vulnerable to severe tidal inundation during storms which has resulted in substantial flood damages, loss of life and hardship to hundreds of families evacuated during time of storm.

The study discloses that the following improvements are economically feasible: (a) combined shore and hurricane protection at Madison Township; (b) shore protection at Matawan Township and Borough of Union Beach; and (c) hurricane protection at the Borough of Keansburg and East Keansburg. These improvements provide for beach fill, groins, levees and interior drainage facilities. Stability of the fill would be accomplished by periodic replenishment of losses as a maintenance feature. The estimated total first cost, exclusive of preauthorization studies, is \$4,984,000 of which \$4,853,000 is for construction and \$131,000 is for lands, easements and rights-of-way. It is determined that the improvements are economically justified and adoption of a Federal project is warranted. It is also determined that shore protection work completed by the State of New Jersey in 1957 at the Borough of Keansburg is economically justified and that reimbursement to local interests for part of the cost of this work is warranted on the basis of precedent.

The District Engineer therefore recommends, subject to certain conditions of local cooperation as outlined in paragraph 127, adoption of the foregoing improvements as a Federal project at a first cost to the United States presently estimated at \$3,208,000 (64 percent of the total first cost of the project) which is equivalent to the full extent of Federal participation permitted under present Federal law and policy governing apportionment of costs of beach erosion control and hurricane protection improvements. Reimbursement to local interests by the United States in the amount of \$28,000 for the shore protection work completed at the Borough of Keansburg is also recommended.

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
111 EAST 16TH STREET
NEW YORK 3, NEW YORK

NANGS

30 November 1960

SUBJECT: Cooperative Beach Erosion Control and Interim Hurricane Study
(Survey) of Raritan Bay and Sandy Hook Bay, New Jersey

THRU: Division Engineer
U. S. Army Engineer Division, North Atlantic
New York, New York
ATTENTION: NADEN-R

TO: The Chief of Engineers
Department of the Army
Washington 25, D. C.
ATTENTION: ENGCW-P

I. AUTHORITY

1. The subject report is a combined report of cooperative beach erosion control and hurricane studies. The authorizations for these studies are as follows:

a. The cooperative beach erosion control study was initiated by the Department of Conservation and Economic Development, State of New Jersey, in letter dated 6 January 1955 requesting amendment of the State's basic application of 22 September 1952 to include a study of the shore fronts of Raritan Bay and Sandy Hook Bay. In accordance with Section 2 of Public Law 520 (River and Harbor Act), 71st Congress, approved 3 July 1930, as amended and supplemented, the Chief of Engineers on 15 August 1955 approved a supplemental agreement dated 25 June 1955 amending the basic application to include appendix III which provides for study of the shore fronts from the east side of the railroad pier in South Amboy at the mouth of the Raritan River to the Highlands bridge at the mouth of the Shrewsbury River. The authority of the State to participate in this study was established by Chapter 258, N.J.L. 1946 and Chapter 448, N.J.L. 1948 and appropriation acts of that state.

b. The hurricane study was authorized by Public Law 71, 84th Congress, 1st Session, approved 15 June 1955, which reads:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That: In view of the severe damage to the coastal and tidal areas of the eastern and southern United States from the occurrence of hurricanes, particularly the hurricanes of August 31, 1954, and September 11, 1954, in the New England, New York, and New Jersey coastal and tidal areas, and the hurricane of October 15, 1954, in the coastal and tidal areas extending south to South Carolina, and in view of the damages caused by other hurricanes in the past, the Secretary of the Army, in cooperation with the Secretary of Commerce and other Federal agencies concerned with hurricanes, is hereby authorized and directed to cause an examination and survey to be made of the eastern and southern seaboard of the United States with respect to hurricanes, with particular reference to areas where severe damages have occurred.

"Sec. 2. Such survey, to be made under the direction of the Chief of Engineers, shall include the securing of data on the behavior and frequency of hurricanes, and the determination of methods of forecasting their paths and improving warning services, and of possible means of preventing loss of human lives and damages to property, with due consideration of the economics of proposed breakwaters, seawalls, dikes, dams, and other structures, warning services, or other measures which might be required."

2. The Chief of Engineers by letter dated 1 October 1957 allotted funds for a hurricane survey of Raritan and Sandy Hook Bays from Highlands to South Amboy, New Jersey. The submission of a combined report covering the cooperative beach erosion control study and the hurricane survey was approved by the Chief of Engineers on 12 February 1960.

II. PURPOSE AND SCOPE

3. The purpose of the beach erosion control phase of this survey report is to develop most suitable plans for restoration of the shore and protection of property against erosion along Raritan and Sandy Hook Bays, N. J. The purpose of the hurricane study phase is to develop an adequate plan of protection against hurricane tidal flooding in Madison Township, Keansburg and East Keansburg. While the hurricane phase is complete for these areas, it is an interim study which will be followed by a final study covering the remaining sections of the area. It is also one of a series in preparation which, when completed, will constitute a full hurricane study of the coastal areas as authorized by Public Law 71, 84th Congress.

4. In the preparation of this report, extensive basic data were collected and analyzed. Field data consisting of hydrographic and topographic surveys, sand sampling, borings to determine sources of suitable fill material and foundation conditions, and aerial photography were obtained during 1957-59. Maximum level indicators were installed to supplement existing tide recording gages in the area. Field investigations were made of tidal flood damages in the entire survey area. Office work

consisted of analysis of data pertinent to both the beach erosion and hurricane problems including meteorological data furnished by the U. S. Weather Bureau. Various engineering and special studies were carried out. Designs and cost estimates were prepared and an economic analysis of plans of protection was made. The District Engineer made a reconnaissance of the study area on 4 October 1960.

5. The report was coordinated with various Federal, State and local agencies. A public hearing was held at Long Branch, N. J. on 21 December 1955 to acquaint the people in the area with the purpose of the survey and to enable them to present their views thereon. Testimony was furnished by local interests at this hearing and at another hearing held in Newark, N.J. on 1 February 1956 in connection with the hurricane study of other areas. A number of meetings were held with State and local agencies during development of possible plans of improvement. Details of coordination with other agencies are described in paragraphs 111 to 116.

III. PRIOR REPORTS

6. There are no prior reports which specifically cover beach erosion control or hurricanes in the study area. However, a report on protection of the New Jersey coast from floods due to tide and wind was submitted to Congress by the Secretary of War on 23 November 1949 pursuant to the Flood Control Act of 22 December 1944. This report, which included the Raritan and Sandy Hook Bays area from Keyport to Highlands, concluded that protection of New Jersey coast areas from floods due to tide and wind was not advisable at that time.

7. Numerous reports have been submitted in connection with proposed Federal navigation improvements. Such reports have been the basis for navigation projects for Raritan River, Cheesequake Creek, Matawan Creek, Keyport Harbor, Way Cake Creek, Shoal Harbor and Compton Creek, Sandy Hook Bay at Leonardo, Sandy Hook Bay at Atlantic Highlands and Shrewsbury River. These projects generally provide for dredging of navigation channels mainly for recreational boating. The projects include completed stone jetties at the entrance to Cheesequake Creek and a completed stone breakwater off Atlantic Highlands. Details on these structures are given in appendix E. A summary of the existing navigation projects and the reports on which they are based is given in table 1 which includes other reports pertinent to the subject study.

IV. DESCRIPTION

8. General. The study area consists of about 21 miles of coast in Middlesex and Monmouth Counties, New Jersey, extending along Raritan and Sandy Hook Bays between the entrance to the Raritan River on the west and the Shrewsbury River on the east. Staten Island, New York, forms the north shore of Raritan Bay and Lower New York Bay which is contiguous to Sandy Hook Bay. Sandy Hook, New Jersey, a low-lying peninsula on the east,

Table 1 - Prior reports

Waterway	Report	Project authorization act	Description
EXISTING NAVIGATION PROJECT REPORTS			
Baritan River	H. Doc. 1341, 62d Cong., 3d sess. H. Doc. 127, 70th Cong., 1st sess. H. Doc. 454, 70th Cong., 2d sess. Rivers and Harbors Committee Doc. 31, 71st Cong., 2d sess. Rivers and Harbors Committee Doc. 74, 74th Cong., 2d sess. Unprinted report on file in the Office, Chief of Engineers	2 March 1919 3 July 1930 3 July 1930 3 July 1930 26 August 1937 17 October 1940	Channels 10 to 25 feet deep. Project is about 96 percent complete.
Cheesapeake Creek	S. Doc. 69, 46th Cong., 2d sess.	14 June 1880	West and east stone jetties 995 and 925 feet in length, respectively, and a channel 3 to 5 feet deep. Jetties were completed in 1883. Project is about 45 percent complete.
Matawan Creek	H. Doc. 45, 46th Cong., 3d sess.	3 March 1881	Channel 4 feet deep. Project is about 90 percent complete.
Keyport Harbor	H. Doc. 153, 42d Cong., 3d sess.	2 August 1882	Channel 8 feet deep. Project completed in 1911.
Way Cake Creek	H. Doc. 624, 77th Cong., 2d sess.	2 March 1945	Channel 8 feet deep. No work done.
Shoal Harbor and Compton Creek	H. Doc. 58, 73d Cong., 1st sess. H. Doc. 673, 76th Cong., 3d sess. H. Doc. 89, 82d Cong., 1st sess.	30 August 1935 2 March 1945 3 September 1954	Channels 8 to 12 feet deep. Project is about 78 percent complete. Local request for stone jetties extending into Sandy Hook Bay for protection at the mouth of the creek was found unjustified (see H. Doc. 89).
Sandy Hook Bay at Leonardo	H. Doc. 108, 81st Cong., 1st sess.	17 May 1950	Channel 8 feet deep. Project completed in 1957.
Sandy Hook Bay	H. Doc. 292, 75th Cong., 1st sess.	26 August 1937	Rubble-mound breakwater about 4,000 feet in length and dredging of an anchorage 8 feet deep. The breakwater was completed in 1940 and the dredging in 1941.
Shrewsbury River	H. Doc. 1296, 62d Cong., 3d sess. H. Doc. 157, 71st Cong., 2d sess. Rivers and Harbors Committee Doc. 31, 74th Cong., 1st sess. H. Doc. 265, 81st Cong., 1st sess.	2 March 1919 30 August 1935 30 August 1935 17 May 1950	Channels 6 to 12 feet deep, turning basin and anchorage 6 feet deep. Project is about 57 percent complete.
OTHER PERTINENT REPORTS			
Cheesapeake Creek	Unfavorable preliminary examination report submitted to Congress by the Secretary of the Army on 7 January 1949.	--	Indicated that raising of the existing Federal jetties would not materially alleviate shore erosion nor provide adequate protection for property at the entrance to the creek.
Sandy Hook Bay at Leonardo	Partially favorable preliminary examination report submitted to the Chief of Engineers by the Division Engineer, North Atlantic Division on 11 March 1946.	--	Concluded that breakwaters and dredging desired by the U. S. Navy are not justified from a commercial navigation standpoint and that the work can best be accomplished with military funds. The Navy submitted a preliminary report which included data on waves and swells in the Sandy Hook Bay area.
Sandy Hook Bay	Unfavorable survey review report submitted to Congress by the Secretary of the Army on 9 December 1948.	--	Concluded that the existing Federal breakwater at Atlantic Highlands provides a measure of protection against storm waves and that modification of the existing project should be deferred until the adequacy of the breakwater has been demonstrated through actual work.

separates the Atlantic Ocean from Sandy Hook Bay. The approach to the bay from deep water in the ocean is through a 6-mile wide opening between Sandy Hook and Rockaway Point to the northeast which is near the western extremity of Long Island, New York.

9. The adjacent terrain ranges from high bluffs near the west and east ends of the study area to low marshlands which are partially inundated by spring tides. Low narrow beaches front most of the area. A number of tidal creeks intersect the shore line.

10. The offshore hydrography is mostly very flat and shallow, with the 12-foot mean low water depth contour generally located over a mile offshore except in the easterly portion of the study area where the depths are greater. The coast is directly exposed to storms from the northerly quadrants.

11. The principal communities located in the study area include the City of South Amboy, Borough of Sayreville and Madison Township in Middlesex County, and Matawan Township, Borough of Keyport, Borough of Union Beach, Raritan Township, Borough of Keansburg, Middletown Township, Borough of Atlantic Highlands and Borough of Highlands in Monmouth County. There are also a number of unincorporated communities within the townships.

12. Published maps of the study area are U. S. Coast and Geodetic Survey Charts Nos. 70, 286, 369, 375, 824, 1000, 1108 and 1215, scales 1:15,000 to 1:1,200,000; Air Photo Compilation sheets T-5100, 5101, 5102, 5103 and 5109 of the U. S. Coast and Geodetic Survey, scales 1:5,000 to 1:10,000; U. S. Geological Survey quadrangles of South Amboy, Keyport and Sandy Hook, scale 1:24,000; Army Map Service sheets for the same quadrangles, scale 1:25,000; and State of New Jersey Department of Conservation and Development sheets for Amboy and Navesink, scale 1:24,000, and topographic series sheet 29, scale 1:63,360. Other maps published by the Army Map Service are the New Brunswick and Sandy Hook quadrangles, scale 1:62,500. Plates 1 to 4 and photo 1 accompanying this report also show the study area.

13. Population. The permanent population of the communities in the study area is over 142,000 according to preliminary 1960 census data obtained from the U. S. Bureau of the Census. During the summer months the population is greatly increased by vacationists who are attracted by the water-front recreational facilities. The change in population since 1930 in the immediate area and in tributary counties which are about one-hour travel time from the study area is given in table 2.

14. The immediate area is experiencing a rapid growth in population due to a boom in residential construction. Forecasts made in 1955 indicate that the population in the counties within the study area may more than double by 1975.

Table 2 - Population data^(a)

Locality	1960	1950	1940	1930	Percent increase 1930-1960
<u>Middlesex County:</u>					
City of South Amboy	8,379	8,422	7,802	8,476	1 ^(b)
Borough of Sayreville	22,506	10,338	8,186	8,658	160
Madison Township	22,716	7,366	3,803	2,566	785
Total	53,601	26,126	19,791	19,700	172
<u>Monmouth County:</u>					
Matawan Township	7,345	3,888	2,633	2,496	194
Borough of Keyport	6,435	5,888	5,147	4,990	29
Borough of Union Beach	5,868	3,636	2,076	1,893	210
Raritan Township	15,287	2,763	1,662	1,568	875
Borough of Keansburg	6,833	5,559	2,904	2,190	212
Middletown Township	39,498	16,203	11,018	9,209	329
Borough of Atlantic Highlands	4,096	3,083	2,335	2,000	105
Borough of Highlands	3,543	2,959	2,076	1,877	89
Total	88,905	43,979	29,851	26,223	239
Total study area	142,506	70,105	49,642	45,923	210
Middlesex County	431,638	264,872	217,077	212,208	103
Monmouth County	333,235	225,327	161,238	147,209	126
Union County	503,333	398,138	328,344	305,209	65
Essex County	919,692	905,949	837,340	833,513	10
Hudson County	607,250	647,437	652,040	690,730	12 ^(b)
Total	2,795,148	2,441,723	2,196,039	2,188,869	28

(a) Based on U. S. Bureau of the Census statistics for 1930, 1940 and 1950 and its preliminary figures as of August 1960.

(b) Decrease.

15. Shore development and activities. The development of the shore is primarily residential and recreational in character with some commerce and industry. Residences along the shore are mainly small cottages, many of which are summer dwellings. Commercial and industrial development in the study area include a chemical and miscellaneous manufacturing plants at Union Beach, a fish factory producing fertilizer and fish oils at Port Monmouth, a fuel oil storage terminal at Atlantic Highlands, and the usual retail establishments associated with the local population. A U. S. Navy depot is at Leonardo.

16. Recreational boating is a popular activity in the area. There are numerous small piers and bulkheads along the shore including a large marina at Atlantic Highlands to accommodate recreational craft. An amusement center is located in Keansburg. Cheesequake State Park in the interior of Madison Township has facilities for picnicking and camping.

17. Transportation. The study area is served by both railroad and highway facilities. The Central Railroad of New Jersey and first-class highways including the Garden State Parkway provide the major means of land transportation. Access to various points on the shore is provided by local streets. Two ferries operate from New York City to Keansburg and Atlantic Highlands during the summer months. A private airport located in Port Monmouth is used in connection with the fish factory in that area.

18. Ownership and accessibility of shore. The Federally-owned shore comprises one percent of the total study frontage. The remaining 22 and 77 percent are respectively non-Federal public and privately-owned shores. Private shore publicly used is 15 percent of the total study frontage. Table 3 gives a breakdown by locality of the various frontages. Details are shown on figure F-1 of appendix F.

19. Property values. The estimated real value of lands and improvements of the communities in the study area and the portions thereof which are located on the flood plain are given in table 4.

20. Pollution. Substantial pollution abatement measures have been taken in the Raritan Bay and Sandy Hook Bay area. Ten sewage treatment plants have been constructed since 1928 at an estimated cost of \$34,490,000. The largest plant is the one built at the Borough of Sayreville by the Middlesex County Sewerage Authority in 1958 which handles wastes from a number of communities and industries in the Raritan River valley. These facilities treat large quantities of effluent from areas where wastes were previously discharged in a raw state.

21. Operation of the new Middlesex County treatment plant has resulted in improved conditions. This is indicated in a report entitled "Raritan River-Raritan Bay Survey" issued in March 1960 by the Chief Chemist of the Middlesex County Sewerage Authority and the Principal Public Health Engineer of the New Jersey State Department of Health. The report evaluates sanitary surveys of water quality before and after operation of the plant. Details from this report as well as other data on the matter of water pollution are given in appendix G.

22. The Interstate Sanitation Commission has classified the waters of Raritan and Sandy Hook Bays as Class A. This classification is given to water areas which are expected to be used primarily for recreational purposes, shellfish culture or the development of fish life.

Table 3 - Ownership and use of shore (feet)
(As of March 1960)

Locality(a)	Ownership			Total	Private shore publicly used
	Federal	Non-Federal public	Private		
City of South Amboy	0	2,680	1,820	4,500	0
Borough of Sayreville	0	4,500	3,100	7,600	0
Madison Township	0	2,715	7,580	10,295	6,180
Matawan Township	0	0	8,520	8,520	5,180
Borough of Keyport	0	1,399	5,901	7,300	100
Borough of Union Beach	0	1,133	14,967	16,100	300
Borough of Keansburg	0	4,971	5,829	10,800	4,217
Middletown Township	1,110	4,230	17,760	23,100	0
Borough of Atlantic Highlands	0	1,250	13,250	14,500	0
Borough of Highlands	0	1,818	7,682	9,500	800
Total	1,110	24,696	86,409	112,215	16,777
Percent of total	1	22	77	100	15

(a) Raritan Township has no frontage on the bay.

Table 4 - Estimated real value of land and improvements (dollars)
(As of 1960)

Locality	Entire locality	Portion of locality on flood plain(a)
City of South Amboy	30,017,000	5,100,000
Borough of Sayreville	147,027,000	500,000
Madison Township	91,345,000	1,100,000
Matawan Township	21,100,000	600,000
Borough of Keyport	23,616,000	500,000
Borough of Union Beach	14,160,000	3,700,000
Raritan Township	44,393,000	1,500,000
Borough of Keansburg	21,799,000	18,600,000
Middletown Township	161,687,000	9,400,000
Borough of Atlantic Highlands	17,105,000	1,000,000
Borough of Highlands	10,736,000	8,200,000
Total	583,285,000	50,200,000

(a) Area within flood line shown on plates 2, 3 and 4.

V. THE PROBLEM AND IMPROVEMENTS DESIRED

23. The problem. The problem in the study area is a combination of shore erosion from wave attack and inundation from storm tides. This has resulted in loss of life, hardship to hundreds of families evacuated during time of flood and considerable property damage. The hardest hit communities are Madison and Matawan Townships, the Boroughs of Union Beach and Keansburg, Middletown Township and the Borough of Highlands. In addition to upland property damage, there has been extensive damage to boats and water-front terminal facilities, particularly in the Boroughs of Keyport and Atlantic Highlands.

24. Improvements desired. A public hearing was held on 21 December 1955 at Long Branch, N. J. to obtain information for use in the preparation of this report. The Congressman from the Third New Jersey District, State, county and municipal representatives and private interests attended the hearing. Others in attendance were representatives of the U. S. Weather Bureau and the U. S. Navy. Local interests also presented testimony in regard to the subject study at a public hearing held in Newark, N. J. on 1 February 1956 in connection with the hurricane investigation of another area in New Jersey. Details of the improvements desired, reasons advanced and other pertinent information furnished at both hearings are given in appendix L.

25. During the course of the investigation, meetings were held with local officials on 3 April 1959 and 21 July 1960 at Freehold, N. J. and on 5 August 1960 at New Brunswick, N. J. The pertinent views and desires expressed at the meetings, at the public hearings mentioned in the preceding paragraph, and during other informal meetings are summarized below.

26. Local interests desired protection against beach erosion and tidal flooding including an adequate hurricane warning system. The need for Federal participation in the cost of protective works was stressed because of the limited local financial resources. In this connection it was requested that some local communities be permitted to finance the cost on a long-term installment basis. Reimbursement by the Federal Government for beach erosion control work done by the State of New Jersey subsequent to initiation of the subject cooperative study was also requested.

27. A report on damage to public facilities resulting from the storm of 6-7 November 1953 was submitted by the Chairman of the New Jersey State Legislative Commission to Study Sea Storm Damage at the hearing in Long Branch. The report concluded that the cost of repair of these facilities imposed a serious financial burden on the coastal communities and recommended that the State of New Jersey appropriate funds to assist in repair of the damage to the extent of 50 percent of the cost.

28. Local interests generally favored protection by beach fill which would also provide for recreation. A willingness to provide additional recreational facilities such as bathhouses and parking fields was indicated by some local officials. The following specific requests for protection were made.

a. Construction of a bulkhead to protect the sewage treatment plant at Morgan in the Borough of Sayreville.

b. Extension of existing bulkheads in Madison Township.

c. Removal of silt deposits from mouth of Conaskonk Creek to facilitate drainage in Union Beach.

d. Construction of groins at Point Comfort in Keansburg to retain fill in this area which is subject to severe erosion.

e. Construction of an offshore breakwater off Keansburg to protect fill from erosion.

f. Construction of an offshore breakwater to protect the piers at the U. S. Navy depot at Leonardo.

29. In justification of proposed improvements, local interests indicated that loss of life and property damage would be reduced, land would be saved from erosion, and indirect losses due to loss of use of facilities, cessation of business and interruption to traffic would be decreased.

VI. FACTORS PERTINENT TO THE PROBLEM

30. Climatology. The climate of the Raritan Bay and Sandy Hook Bay vicinity is temperate with an average annual temperature of 52 degrees Fahrenheit. The extreme temperatures observed were 31 degrees below zero and 110 degrees above. The average growing season is about 180 days and the relative humidity averages about 70 percent. The average annual precipitation is approximately 44 inches; the observed annual extreme values at an individual station were 61.70 and 29.94 inches at Sandy Hook, N.J. in 1878 and 1955 respectively. The distribution of precipitation throughout the year is rather uniform with a slightly higher amount during the summer months. Maximum precipitation during a hurricane was recorded as 24 inches at Ewan, N. J. for the storm of 1 September 1940 which passed far off the coast. Details on rainfall associated with storms are given in appendix C.

31. Geomorphology. The study area lies in the subaerial portion of the New Jersey Coastal Plain. Some conspicuous features of the subaerial portion of the Coastal Plain are the marshes which border streams and the submerged or drowned valleys. A detailed description of the geomorphology of the study area is presented in appendix A.

32. Surficial deposits. The strata in the study area dip toward the southeast, as is typical of the Coastal Plain with younger formations outcropping to the south. The entire study area is in the zone of Cretaceous deposits, consisting of marls, gravels, sands and clays. At the eastern portion of the study area, Tinton loam and Red Bank sand appear at the surface.

33. Subsurface geology. The subsurface geology of the Coastal Plain has been determined by study and correlation of well logs and interpretation of seismic profiles. The Coastal Plain consists of Cretaceous to Recent sediment deposits. The Cretaceous sediments are of prime importance in the study area.

34. Littoral materials. The following is a brief description of the characteristics and sources of littoral materials. Details on characteristics are given in appendix A.

35. Characteristics. Sand samples of bottom materials were taken in 1957 by the U. S. Army Corps of Engineers, to determine the characteristics of littoral materials. Locations of samples are shown on plates 2 to 4, and a tabulation of the statistical parameters used to characterize the sand is given in table A-1 of appendix A.

36. Generally, the mechanical analyses indicate poor beach material at the eastern and western extremities of the study area and good material in the central part. The offshore areas generally consist of muddy type materials, except in the area extending from Keansburg to Port Monmouth.

37. Sources. The exact sources of littoral material along the study area frontage are not known. However, it appears that the supply is limited since only small quantities of sand are trapped at groins. That material which is available is believed to originate from (1) sedimentation of streams, (2) erosion of the coast itself, and (3) longshore currents carrying material around Sandy Hook from the Atlantic Coast of New Jersey. Some material may reach the area from the offshore bottom and wind deposition.

38. The high percentage of mud offshore seems to indicate that little material is being carried around Sandy Hook into Sandy Hook Bay. From available evidence, it appears that most of the littoral material in the study area comes from headland erosion of the shore and sedimentation of streams and rivers emptying into Raritan Bay and Sandy Hook Bay.

39. Littoral forces. Waves, currents, winds, ice and tides affect the movement of littoral materials. Data regarding these forces in the study area are presented in appendix B and summarized in the following paragraphs. Information on the effect of storms on the shore are contained in appendices C and K.

40. Waves. The study area is affected by ocean waves entering the opening between Sandy Hook and Rockaway Point and by waves generated by local winds blowing across the open bay. Two wave diagrams on plate 12, which indicate the height and direction of waves outside the entrance to New York Harbor and in the bay in the vicinity of Point Comfort at Keansburg, N. J., show that highest waves approach from the east and east-northeast. Ocean waves entering the bay are modified by the effects of refraction and shoaling with resulting changes in wave height and direction.

Computations indicate that waves as high as 14 feet are possible off Point Comfort under certain storm conditions. Estimates obtained from experienced seafaring personnel disclose that, after severe ocean storms, swells are as high as 15 feet between Sandy Hook and Rockaway Point. It has been estimated that these swells are reduced to a height not in excess of 6 feet in the area off the Navy piers in Sandy Hook Bay. Storm wave heights of about 5 feet have been reported at Atlantic Highlands.

41. Currents. Tidal currents along the shore of the study area are generally weak except at the entrances to Raritan and Shrewsbury Rivers where the average velocity at strength of the current is 1.8 and 2.6 knots, respectively. A large part of the tidal circulation in the bay occurs in relatively deep water along an east-west axis approximately 2 miles offshore from the study area.

42. Winds. Wind data from observations made at Sandy Hook, N. J. as well as data on winds observed at sea are presented on plate 12. The data for Sandy Hook show that almost 20 percent of the total wind duration is from the northwest with around 15 percent each from the northeast and south directions. At sea, the winds from the westerly quadrants prevail. Of a total of 815 maximum daily velocity observations of winds over 30 miles per hour during the period 1924 to 1934 at Sandy Hook, 316 or about 40 percent were from the northwest. Table B-1 of appendix B summarizes data on maximum winds at Long Branch, N. J. about 10 miles south of the eastern end of the study area. It indicates that winds as high as 78 miles per hour have been recorded at this station during recent storms.

43. Ice conditions. There are no known problems due to ice conditions along the study area frontage.

44. Tides. Tides along the study area are semi-diurnal and have a mean range varying from 5.0 feet at South Amboy to 3.8 feet at Highlands. The spring range varies from 6.0 feet to 4.6 feet at the respective locations.

45. The maximum recorded storm water elevation in the immediate vicinity of the study area was 9.5 feet above mean sea level, as obtained from a tide gage at Perth Amboy, N. J. on 25 November 1950. The peak surge for the same storm at this location was 10.4 feet. Figure H-1 of appendix H shows a stage history of this storm tide. It is estimated from high water marks that the water levels along the study area during the hurricane of 12 September 1960 (Donna) exceeded those of the 1950 storm by about 0.5 foot. Additional tidal data for recent storms are given in table B-2 of appendix B. Data on the estimated frequency of high tides in the bays are given in figure K-1 of appendix K.

46. Storms. The study area is subject to damage from hurricanes and extratropical cyclones which are also known as northeasters. The characteristics of these storms are described below. Details on their effect on the study area are contained in appendices C and K.

47. The hurricanes originate principally during the months of August, September and October in the belt of equatorial calms in the Caribbean area and in the vicinity of the Cape Verde Islands. Hurricanes are those tropical cyclones which have a central barometric pressure of 29.0 inches or less and wind velocities in excess of 75 miles per hour. However, the winds frequently weaken to maximum velocities on the order of 60 miles per hour upon reaching the North Atlantic Coast. In the northern hemisphere, the revolving winds blow in a counter-clockwise direction about an eye or calm center. The diameters of the storms vary from 50 to over 500 miles, the velocity of circular air movement being greatest near the center of calm and decreasing to relatively light winds at the outer periphery. The storm moves forward in a motion of translation, at a moderate speed typically 25 to 30 miles per hour when approaching the study area, but at times reaching 60 miles per hour. In most cases, tropical storms have moderated considerably from their peak intensity before reaching the study area. A number of notable exceptions to this general rule have occurred, and hurricanes of devastating intensity have struck the area. A map indicating the paths of major hurricanes for the New York-New Jersey coast is shown on plate 12.

48. In a northeaster wind speeds are generally not as great and central pressure is not as low as they are in a severe hurricane. The wind field of a northeaster is less symmetrical than that of a hurricane and covers a much greater area, and the forward motion of the storm is more likely to slow down. Thus, it may produce prolonged periods of on-shore winds which may result in longer periods of flooding. An example of this is indicated on figure H-1 of appendix H which shows a comparison between the surge of the 25 November 1950 northeaster and the predicted surge for the September 1938 hurricane transposed to a position critical to the study area.

49. Available records show that of 199 storms recorded between 1635 and 1960, six were unusually severe, 16 were severe, 81 were moderate and 96 others threatened the area. Damaging effects on the study area have been unusually severe during the following storms. All these storms were hurricanes with the exception of the November 1950 storm, which was a northeaster (extratropical cyclone).

1723, July 29
1788, August 19
1821, September 3
1944, September 14
1950, November 25
1960, September 12 . . .

50. Storm frequency. The frequency of storm occurrences per 100 years in the study area for the various categories of estimated degree of intensity is shown in table 5. The frequency of unusually severe storms of 3.6 per 100 years consists of a frequency of 1.9 for hurricanes during the period 1701 to 1960 and a frequency of 1.7 for extratropical storms

between 1901 and 1960. The longer period of record has been used for hurricanes of this intensity since it is believed to be reasonably complete. Data for extratropical storms prior to 1901 are considered incomplete because storm dates were obtained through the use of high tide records which are only complete for the shorter period. The frequency of severe storms of 14.2 per 100 years consists of 2.5 for hurricanes and other tropical storms between 1801 and 1960, and 11.7 for extratropical storms between 1901 and 1960. Additional data on storm frequency and a separation of frequencies between tropical and extratropical storms of lesser intensity are contained in appendix C.

Table 5 - Estimated storm frequency

Intensity	Period of record ^(a)	Frequency per 100 years
Unusually severe	1701-1960	3.6
Severe	1801-1960	14.2
Moderate	1901-1960	55.0
Threatened the study area	1901-1960	110.0

(a) These periods are for hurricanes and other tropical storms. For extratropical storms (northeasters), the period of record used for all categories is 1901-1960.

51. A separate estimate of frequency based on available tide records and data on central barometric pressure frequency prepared by the U. S. Weather Bureau is discussed in paragraphs 31 to 34 of appendix K. A comparison of the estimated storm frequency given in table 5 with the frequency estimate developed in appendix K indicates a reasonable degree of correlation between the two estimates.

52. Hurricane warning. The U. S. Weather Bureau as part of its responsibility for improved weather services in connection with major storms and hurricanes has established a "severe weather" network along the Atlantic Coast, utilizing powerful radarscopes. Radar installations at Nantucket, Atlantic City and Cape Hatteras are part of the network linked to the Weather Bureau office in New York City by means of teletype communication. During periods of hurricane threat the New York City office issues warnings to the public by radio over station WNYC and other radio stations every hour. In addition, teletype weather bulletins are available from that office to anyone who subscribes to the teletype service. In order to provide continuous data on storm water levels, tide gages at the Battery and Willets Point have been remoted to Weather Bureau offices in New York City for use in the warning service. A general description of the existing hurricane warning service and suggestions for improvement are contained in chapter 6 of the pre-printed Report No. 5 of the National Hurricane Research Project prepared by the U. S. Weather Bureau under Public Law 71, 84th Congress, 1st Session. Efforts are also being made by the Weather Bureau

to inform all public agencies or officials of the potential hazards of hurricanes and to suggest the establishment of emergency hurricane plans which could be readily activated at times of a threatened hurricane for the purpose of taking the necessary steps after warnings are received, to minimize loss of life and damage to property.

53. In addition, a warning system known as CONELRAD is available to alert the public to threats of severe weather conditions. This system which has been in operation since 1951 for use in the event of enemy attack was adapted in 1958 for dissemination of storm warnings. Established procedures require the local U. S. Weather Bureau representative to alert AM, FM and TV broadcast stations in the event of an impending severe weather condition, abnormal rising water or other threat by the elements to life and property. In the New York-New Jersey area this alert is given by the Weather Bureau via its teletype service in a form of a bulletin describing the weather conditions that is to be broadcast to the public using CONELRAD procedures. The bulletin can be received on standard radio receivers on the normal frequency of each radio station.

54. Federal Flood Insurance Act of 1956 (Public Law 1016, 84th Congress). This act, approved 7 August 1956, authorized the establishment of a program of Federal insurance against damage from any flood, tidal wave, wave wash or other abnormally high tidal water. In adopting the act, the 84th Congress found that the safeguards of insurance are a necessary adjunct of preventive and protective means and structures. The face amount of insurance which would be issued under the act is limited to \$250,000 per person and may not exceed \$10,000 on any dwelling unit including any structures and personal property connected therewith. No insurance would be issued on any property declared by a State or local zoning authority to be in violation of State or local flood zoning laws. The act also establishes a Government-guaranteed loan program under which loans of up to \$10,000 a home or \$250,000 a person would be available at an interest rate not to exceed 4 percent. However, this program has not yet been implemented.

55. Shore history. The following paragraphs present data on shore line changes; offshore depth changes; prior corrective action and existing structures; profiles; and volumetric accretion and erosion. Details on the foregoing items are given in appendices D and E.

56. Shore line changes. The high water shore line from South Amboy to Highlands for various periods since 1836 is shown on plates 5 to 7. To facilitate analysis of the changes which have occurred, the frontage was divided into four shore sections which are separated by large creeks. A summary of the changes during the period of record is given in table 6.

Table 6 - High water shore line changes (feet)^(a)

Period	South Amboy to Cheesequake Creek		Cheesequake Creek to Matawan Creek		Matawan Creek to Compton Creek		Compton Creek to Shrewsbury River	
	Total	Average annual	Total	Average annual	Total	Average annual	Total	Average annual
1836 to 1855-56	-160	-8.0	-113	-5.6	-157	-7.8	-48 ^(b)	-2.4 ^(b)
1855-56 to 1886	(c)	(c)	+ 32	+1.1	(c)	(c)	(c)	(c)
1886 to 1926	+ 44	+1.1	+ 33	+0.8	- 15	-0.4	(c)	(c)
1926 to 1932-34	- 14	-1.8	- 10	-1.0	+ 20	+2.4	- 9	-1.1
1932-34 to 1957	+810 ^(d)	+33.7 ^(d)	(c)	(c)	- 4 ^(e)	-0.2 ^(e)	+75 ^(f)	+3.1 ^(f)
1836 to 1957	+680 ^(d)	+5.6 ^(d)	-55	-0.5	-154 ^(e)	-1.3 ^(e)	(c)	(c)

(a) Minus indicates erosion and plus indicates accretion.

(b) Excluding changes at the mouth of the Shrewsbury River for this period.

(c) Negligible.

(d) Includes the effects of 6,718,000 cubic yards of artificial fill placed during this period.

(e) Includes the effects of 318,000 cubic yards of artificial fill placed during this period.

(f) Includes the effects of 892,000 cubic yards of artificial fill placed during this period.

57. Analysis of table 6 indicates that greatest shore line erosion occurred during the earliest period of record with rates of recession as high as 8 feet per year. In more recent periods the changes are not as great and may be largely due to extensive bulkhead construction which has helped in holding the shore. Artificial fill placed along the shore in recent years accounts for most of the accretion indicated in the 1932-34 to 1957 period.

58. Offshore depth changes. Data from surveys made at various times from 1836 to 1957 were used to obtain the locations of the 6, 12 and 18-foot depth contours as indicated on plates 5 to 7. The contours exhibit erratic movement without any apparent pattern except that the 6-foot contour has remained practically parallel to the shore along most of the study area during the period of record. Since 1836 there has been offshore and onshore movement of the depth contours, generally over a zone of several hundred feet, but without any consistency.

59. Prior corrective actions and existing structures. Improvements for beach erosion control and hurricane protection have largely been undertaken by the State and local governments and private interests and to a limited extent by the Federal Government. The protective works consist of several bulkheads and groins, a few seawalls and some artificial beaches built by sand dredged from the bay. Included among the shore structures are jetties at the mouth of Cheesequake Creek and Compton Creek and a breakwater off Atlantic Highlands. Details on the extent, cost and effectiveness of the work are given in appendix E. Photos 6 to 11 show the typical protective works in the study area. Plates 2 to 4 show the locations of existing structures.

60. Records indicate that the Federal Government through the Works Progress Administration has participated in financing the construction of some protective works, however details of the extent of the work are not available. The jetties at Cheesequake Creek were built by the Federal Government in 1882-83 under an authorized navigation project at a cost of \$40,000 which includes the cost of dredging and other work. Since construction of the jetties there has been localized accretion of the shore east and west of the creek near the inshore ends of the structures. The breakwater off Atlantic Highlands, also part of a Federal navigation project, was completed in 1940. The total cost of the project including \$53,790 contributed by local interests was \$562,726, of which about 10 percent is for dredging an anchorage. The breakwater has not materially affected the shore line in the area.

61. Since 1929 considerable protective work has been accomplished by the State of New Jersey in cooperation with county and municipal governments in the study area. The cost has been around \$1,000,000. About one-half was borne by the State and the remainder by other local governments. Details are given in table E-3 of appendix E. The cost of additional work performed by private interests is not known, but it is believed to run into several hundred thousand dollars.

62. Numerous groins constructed in the area have generally not been successful in trapping material as is indicated in photo 10. The lack of any appreciable accretion is also evident at the Compton Creek east jetty. Bulkheads and seawalls have been generally effective in holding the shore, but most of the beaches seaward of these structures have been lost by erosion. Although experience with artificial beaches has been relatively recent, this type of protection appears to have considerable merit. Artificial beaches in the Keansburg area built by the State in 1954 and 1957 up to an elevation of 13 feet above mean low water (10.6 feet, mean sea level) provide a measure of protection and a suitable recreational beach. There generally has not been significant losses of the beach except for a small area at Point Comfort where the high water line receded around 50 feet about a year after placement of fill without the occurrence of a severe storm in that period.

63. Profiles. Plates 8 to 10 show 29 profiles extending from shore to approximately one mile offshore, based on a survey made in 1957. Data from surveys made as early as 1836 were plotted on 14 of these profiles and are shown on plate 11 for comparative purposes.

64. Typical present foreshore slopes generally vary from about 1 on 15 to about 1 on 40 with the average close to 1 on 30. Underwater slopes are very flat and are around 1 on 400.

65. Plate 11 indicates that there have been relatively minor long-term changes in the configuration of the bay bottom during the period of record. Deepening of the bottom at some locations is the result of dredging operations. Records of seasonal changes in the study area are not available.

66. Volumetric accretion and erosion. The relatively small quantity of material trapped at existing jetties and groins in the study area indicates that the quantity of littoral drift and volume of accretion along the shore are not appreciable. A study of hydrographic surveys made since 1836 (see plate 11) also fails to disclose any significant accretion or erosion in the offshore areas.

67. Estimates of volumetric erosion along the frontage of the study area were made on the basis of available high water shore line data, in view of the lack of other survey information. As indicated in appendix D, the estimated average rates of erosion generally are in the order of 1 to 2 cubic yards per linear foot of shore per year.

VII. EXTENT AND CHARACTER OF FLOODED AREA

68. Extent of flooded area. The Hurricane of 12 September 1960 (Donna), the maximum of record, caused tidal inundation over an area of more than 4,000 acres, of which about one-third is developed. As indicated

by the flood line shown on plates 2 to 4, every community in the study area was affected. Large sections of Union Beach, Keansburg, Middletown Township and Highlands were flooded because of the especially low and flat terrain in these areas. Some localities were inundated to depths as much as 5 feet.

69. Character of development. The development of the area subject to flooding is primarily residential and recreational. These types of development suffer a high proportion of all damage. In addition, there are a number of boatyards, public facilities, and small businesses which are affected.

70. Effect on transportation. During times of flooding, hardships are experienced in the area as a result of inundation or washout of bridges, local streets and county and state highways, particularly portions of State Highway 35 in Madison and Matawan Townships. In some cases, washouts require extensive bridge and road repairs before normal traffic can be restored. In addition, the facilities of the Central Railroad of New Jersey are affected by storm waters which cause track inundation and washout.

71. Effect on the public. Newspaper accounts indicate that six persons lost their lives in the study area during past storms: two on 16 September 1903, one on 17 November 1935, two on 25 November 1950 and one during the 6-7 November 1953 storm. Evacuation of hundreds of families from flooded areas has been necessary during major storms. All utilities in the area are seriously affected. During the 25 November 1950 storm Keansburg was placed under martial law.

72. Effect on property values. The estimated real value of land and improvements in the study area is given in table 4. Protection of the study area against hurricane damage would undoubtedly result in an increase in property values. However, no credit has been taken in this report for such enhancement, as this enhancement would be due primarily to prevention of physical damage and improvement in conditions of beach use, benefits from which have already been evaluated. Any additional enhancement benefits would be negligible. For a fuller discussion of the extent and character of the flooded area, see appendix K.

VIII. FLOOD DAMAGES

73. Experienced damages. The hurricane of 12 September 1960 (Donna), the maximum of record, caused about \$6,000,000 (1960 prices) of primary physical and non-physical damage in the study area. Many houses were destroyed or badly damaged. Boats and water-front terminal facilities were hit hard. Beach erosion was extensive. For a more detailed discussion of damages, see appendix K.

74. Average annual losses. Stage-damage curves for all developed areas subject to flooding were prepared from a physical inventory of the study area. A stage-frequency curve developed from available Weather Bureau data and tide data for the general vicinity was correlated with the stage-damage curves to obtain damage-frequency relationships. By the use of mathematical integration, average annual damages were estimated at \$1,074,000 (1960 prices) for the study area.

75. Recurring damages (1960 prices). It is anticipated that conditions in the study area will be restored substantially to those existing prior to the hurricane of 12 September 1960 (Donna) including replacement of structures and facilities destroyed during the storm. On this basis it is estimated from the stage-damage curves (figure K-3), which were developed immediately prior to hurricane Donna, that the recurrence of the maximum tidal heights which accompanied this storm would cause \$7,300,000 of primary physical and non-physical damage, of which about two-thirds would be residential. It is to be noted that the stage-damage curves include the effects of possible occurrence of some storms during the summer vacation period when the activity in the study area is greatest. The lesser damage which resulted from the September 1960 storm given in paragraph 73 is due to the fact that it occurred after the summer season. The primary physical and non-physical damages which would result from occurrence of the design storm surge at time of predicted mean tide are estimated at \$12,000,000. The damages which would result from occurrence of this storm surge at time of high tide would be almost doubled.

IX. ANALYSIS OF THE PROBLEM

76. The shore erosion problem. The area tributary to the shores of Raritan and Sandy Hook Bays has a population of over 2,800,000 persons. This population which has been steadily increasing is creating a demand for additional water-front recreational facilities. Erosion has resulted in a reduction in the width of beaches thereby exposing existing development to wave attack and causing a loss of the beach area available for recreational use. In certain bluff areas, where the beaches are narrow, the waves expend the greater portion of their energy in eroding the bluffs, which results in the loss of public and private property located on these bluffs. The bulkheads and seawalls constructed in the study area by local interests have been generally effective in holding the shore, but most of the beaches seaward of these structures have been lost by erosion. Improvement and stabilization of the shore are needed to protect existing development against damage from erosion and wave attack and to provide larger areas for recreation. Sufficient publicly-owned shores and privately-owned shores open for public use are available at some localities where recreational benefits may be obtained from improvement. Local officials of some municipalities have indicated willingness to provide additional bathhouses and parking areas.

77. The stability of a beach depends primarily on the quantity of sand available to replenish losses from erosion and the sand-transporting forces which act along the beach. In the study area the quantity of

littoral drift is very small as is evidenced by the relatively little accumulation of material at existing groins and jetties. In addition, the direction and quantity of the drift vary from place to place because of change in alignment of the shore and its degree of exposure to wave action. Furthermore, the available supply of littoral drift is interrupted at the mouths of the numerous creeks which intersect the shore. Because of the foregoing factors, the study area may be considered to be divided into a number of relatively short compartments. Under this condition, littoral forces cannot be depended upon to move material to nourish adjacent shore compartments.

78. The shore at a number of locations in the study area has been unstable due to an insufficient supply of littoral drift. Shore structures built by local interests have provided only limited protection against erosion. The quantity of material lost by erosion of the shore is not susceptible to accurate determination due to the lack of adequate survey data. Average rates of volumetric erosion along the study area frontage, as estimated from limited information, are in the order of 1 to 2 cubic yards per linear foot of shore per year. If suitable remedial measures are not undertaken, continued erosion will result in further loss of beaches and damage to property.

79. The hurricane problem. The hurricane problem as distinguished from the shore erosion problem discussed in the preceding paragraphs is concerned with tidal flooding. Storm tides created by high winds and low barometric pressure accompanied by wave action have inundated developed areas with resultant loss of life and property damage. A study of the history of storms dating back to 1635 indicates that unusually severe and severe storms occur in the study area at a frequency of about 3.5 and 14 times per 100 years, respectively.

80. In order to reduce storm damage the State of New Jersey in cooperation with local governments has provided protective beaches and bulkheads. Although the work accomplished offers a measure of protection, the area is still subject to tidal flooding. Additional work is required at some locations to provide adequate protection against storm induced tides.

81. Adequate hurricane warnings are also essential and must supplement any plan of protection for the study area. A hurricane warning system might be instituted by local civil defense authorities to spread warnings issued by the U. S. Weather Bureau in New York City. With such a system in operation, it is expected that the potential hazard of loss of life and damage to property would be reduced. The importance of providing early warning cannot be overemphasized, particularly for the low-lying communities which are especially vulnerable to severe flooding.

82. Consideration should also be given by local authorities to revision of zoning ordinances and building codes with a view to reducing possible hurricane damage in areas where hurricane protection is economically not feasible. Such measures may be used to restrict and regulate

additional development on the coastal flood plain. This may be accomplished by preventing construction in critical areas or limiting the development to a type which would have a relatively low damage potential, such as parks. Building code restrictions which would require minimum first floor elevations for new structures would be desirable. With regard to revision of building codes to require heavy construction of buildings to withstand hurricane wind forces, it is considered that such codes would not be generally appropriate in the study area because of the high cost which would be involved.

83. Methods of correcting problem conditions. As indicated in paragraph 28, local interests have requested certain methods of correcting problem conditions. A discussion of each specific request is given in the following subparagraphs which correspond in letter designation to the subparagraphs of paragraph 28. In addition, the general desires of local interests for protection by beach fill are also discussed.

a. Consideration has been given to the request for construction of a bulkhead to protect the sewage treatment plant at Morgan in the Borough of Sayreville. A careful analysis of all available data reveals that protection of the sewage plant by a bulkhead or levee would not be economically justified.

b. Regarding the request for extension of existing bulkheads in Madison Township it is considered that such an improvement would not be entirely suitable for the locality. Although bulkhead extension would offer a measure of protection, it would not provide a beach which would be desirable in this area. Such a beach would serve as protection and would also be available for recreational use.

c. The removal of silt deposits from the mouth of Conaskonk Creek is requested by local interests in order to reduce the duration of tidal flooding of some areas in Union Beach. They point out that the shoal at the mouth retards the return of floodwaters to the bay for a number of hours. Removal of the shoal would have some effect on reducing the duration of flooding. However, such work would also permit the entry of a larger quantity of water into the area and tend to counterbalance the benefit from a decrease in flood duration.

d. Construction of groins is desired by local interests to hold the beach at Point Comfort in Keansburg. This relatively small area has a long-term history of erosion. The loss of a substantial portion of the fill placed at the Point in 1957, although there has been no significant loss of the material placed along the balance of the Keansburg shore at the same time, is indicative of the erosion problem. Because of the vulnerability of the area to severe erosion, it is considered that groins would be required to insure against unusually high loss of beach during time of severe storm.

e. Construction of a breakwater off Keansburg was requested for the purpose of protecting the shore against erosion. This method of protection would be effective in that it would reduce the intensity of wave

action on the shore. However, the cost of such works would be very high and would greatly exceed the cost of providing groins to hold the shore and replenishing sand lost by erosion.

f. The request for a breakwater at Leonardo was made for the purpose of protecting the U. S. Navy installation in this area. A similar request was made by the Navy in connection with a navigation report submitted in 1946 (see table 1). That report concluded that the work can best be accomplished with military funds. There has been no change in conditions to warrant a change in this conclusion.

84. As indicated in paragraph 28, local interests generally favor creation of a beach which would provide protection as well as an area for recreational use. On the basis of experience in the Keansburg area where, with the exception of localized erosion in a small area, the beach has suffered no significant loss, this method of protection would be practicable for certain locations along the bay frontage. Suitable material for fill can generally be obtained by hydraulic dredge at a reasonable cost. A relatively high elevation beach berm should be provided in areas where protection against tidal flooding is economically feasible. Beach berms with lower elevations should be provided as shore protection measures. A discussion of the required berm elevations and beach sections is presented in the following section on design criteria. The high elevation beach would serve a dual purpose of hurricane and shore protection.

85. Following initial placement of beach fill, its maintenance can be effected by replenishment of losses directly at locations where erosion may occur. This can be accomplished at the estimated annual rates shown in table J-9 of appendix J which are based on estimates of replenishment in the order of 1 to 2 cubic yards per linear foot of shore per year. Consideration was also given to the provision of groins for the purpose of reducing the rate of loss of beach material with consequent lowering of the cost of maintenance by replenishment. Because of the relatively low estimated replenishment quantity requirements and the expectation that groins would reduce only a portion of this quantity, groin construction was considered to be generally uneconomic except in the Point Comfort area which has experienced severe localized erosion. The primary purpose of groins at Point Comfort would be to provide protection for the slope of beach fill for hurricane protection during storms. While some beach erosion benefits may result from groin construction, they would be of minor significance and have not been evaluated.

86. In order to supplement hurricane protection along the bay frontage, levee improvements would be required to prevent the entry of tidal floodwaters along the flanks of the areas to be protected. This would include road and bridge raising, closure structures at railroad crossings, tide gates and appurtenant drainage facilities.

87. A preliminary analysis was made of the economic feasibility of providing hurricane protection and beach erosion control measures at every

community in the study area. The results of this analysis covering the areas where improvement appeared practicable were presented to local officials through the New Jersey State Department of Conservation and Economic Development prior to undertaking any detailed studies of plans of improvement. All comments received from local interests were given careful consideration in the development of detailed plans. Present studies indicate that the following types of improvements would be economically feasible: (a) multiple-purpose shore and hurricane protection at Madison Township; (b) single-purpose shore protection at Matawan Township and Borough of Union Beach; and (c) single-purpose hurricane protection at the Borough of Keansburg and East Keansburg. Further studies will be made of these and other areas where no hurricane improvements have been developed to determine whether such improvements may also be economically justified. Although there has been some localized erosion of a relatively small area at Point Comfort, the beaches completed by local interests in the Borough of Keansburg and East Keansburg in 1954 and 1957 are adequate from a shore protection standpoint and also provide partial protection from tidal flooding.

88. A shore protection project at Leonardo was found to be uneconomic after detailed investigation, although the preliminary analysis indicated some possibility for improvement.

89. It is to be noted that the Borough of Highlands is subject to severe damage from tidal flooding. An analysis discloses that the cost of protecting this area locally would be very high and would exceed the benefits therefrom. However, this problem will be considered further in connection with the separate hurricane study of the Atlantic Coast of New Jersey from Sandy Hook to Manasquan under Public Law 71, 84th Congress, to determine whether an economically-feasible overall plan of protection can be developed for Highlands and the nearby communities affected by flooding from the ocean and Shrewsbury River.

90. It is also noted that some communities in the study area are subject to flooding from surface runoff because of inadequate interior drainage facilities. Provision of storm sewer systems to protect against such flooding would be the responsibility of local interests.

91. Design criteria. The following paragraphs present a summary of the design criteria for the considered plan of improvement which provides for beach fill, groins, levees and interior drainage facilities. Details are given in appendix H and on figure J-1 of appendix J and plates 1A and 13.

92. Top elevation. Top elevations of 15, 10 and 5.5 feet above mean sea level have been selected for protection against tidal flooding, protection against bluff erosion and for proposed beaches fronting low areas,

respectively. The 15-foot elevation for beaches and levees would provide protection against the maximum of record surge of 10.4 feet produced by the extratropical storm of 25 November 1950 recurring coincidental with a predicted mean high tide, including an allowance of about 2 feet for wave run-up. Such a design would provide greater protection than that which would be required against a repetition of the 25 November 1950 storm as it actually occurred, in view of the fact that it struck the area near the time of mean low tide. The 10-foot elevation at bluff areas is proposed for a beach which is designed to dissipate the energy of waves with heights up to about 9 feet before wave action reaches the base of the bluff. Consideration was given to using the 5.5-foot mean sea level beach berm together with stone revetment above this berm as an alternative means of protecting the bluff areas. However, as noted in paragraph 24 of appendix H, the cost of the fill alone for this alternative would be greater than for the recommended design. The additional cost for stone revetment would render this alternative still less economic. The design berm elevation of 5.5 feet for beaches in low areas is approximately the same as the berm elevation of natural beaches in the area.

93. It is to be noted that storm surges greater than the maximum of record are possible in the study area. Predictions made by the Texas A&M Research Foundation as published in Final Technical Report No. 165-3, October 1959, titled "The Prediction of Storm-Tides in New York Bay" indicates surges of 12.3 and 15.3 feet at Sandy Hook for a standard project hurricane and a maximum probable hurricane, respectively, with surges around 20 percent higher at Perth Amboy. Consideration of providing hurricane protection against storms of this intensity discloses that it would greatly interfere with local activities and in some cases would not be economically justified.

94. Beach fill cross sections. The design berm widths and slopes of the beach cross sections are based on engineering judgment and experience with artificial beaches placed by the State of New Jersey in the Keansburg area. Since the existing natural beach slopes in the study area are relatively flat, a design seaward slope of 1 on 20 was selected as best approximating the natural slope of the hydraulic fill to be used. The same design slope was used for the aforementioned beaches placed by the State and these beaches have remained relatively stable with the exception of a few areas of localized erosion.

95. Levees. Levee design has followed published standards of the Office of the Chief of Engineers. Subsurface exploration discloses that a considerable part of the proposed levees would be founded upon swamp material while in some areas the underlying material is largely sand. In swamp areas a surcharge would be required on top of the levee to consolidate the foundation. Impervious cut-offs would be provided in all areas to prevent seepage through the foundation of the levee.

96. Interior drainage. Interior drainage systems which provide for drainage ditches, two small ponding areas and reinforced concrete pipes

with tide gates are proposed to handle surface runoff which would be intercepted by the proposed levees. The systems have been designed to handle a 10-year storm as given in U. S. Department of Agriculture Miscellaneous Publication No. 204 titled "Rainfall Intensity-Frequency Data" by David L. Yarnell, occurring at the time of an average spring tide.

97. Groins. Groin design is based upon requirements for holding the beach fill in the Point Comfort area. The groin profile shown on plate 13 has been selected to meet this criterion. The total groin length would be 260 feet. A spacing of 800 to 900 feet between groins is proposed to prevent flanking.

X. PLAN OF IMPROVEMENT

98. The plan of improvement which provides for shore and hurricane protection at Madison Township, shore protection at Matawan Township and the Borough of Union Beach, and hurricane protection at the Borough of Keansburg and East Keansburg is shown on plates 1A and 13 and figure J-1 of appendix J. The plan provides for beach fill, groins, levees and interior drainage facilities. Pertinent details of the plan with the exception of the drainage facilities are summarized in table 7.

XI. ECONOMIC ANALYSIS

99. Estimates of first cost. Detailed cost estimates showing quantities and unit costs at May 1960 prices are given in appendix J. The estimates of first cost of all work involved in the considered plan of improvement total \$5,031,000 and are summarized in table 8 broken down by principal features and between Federal and non-Federal costs. Included are allowances for contingencies and cost of preauthorization studies, engineering, design, supervision and administration. Of the total cost \$653,000 is for shore protection and \$4,378,000 is for hurricane protection as shown in table 9. The cost to local interests for providing necessary bathhouses and parking fields has not been included. Such facilities would be provided on a self-liquidating basis. The basis for the apportionment of the costs between Federal and non-Federal interests is given later in this report.

100. Estimates of annual charges. A summary of the estimated annual charges broken down by shore and hurricane protection purposes and between Federal and non-Federal interests is given in table 10. Details are contained in appendix J. An interest rate of 2-5/8 percent has been used for both the Federal and non-Federal investments. A review of interest rates on bonds issued by the State of New Jersey and consultation with the co-operating agency disclosed that the above interest rate is reasonable for the type of improvement involved. This rate has also been applied to the lands to be acquired for the proposed improvement, since it is doubtful whether they would have a higher productivity for other purposes and the use of a higher interest rate for this item would have a negligible effect on the economics of the improvements. A useful life of 50 years has been assumed for amortizing the project. No interest during construction is included since the initial work would require less than two years for completion. The basis for apportionment of the annual charges between Federal and non-Federal interests is given later in this report.

Table 7 - Pertinent details of plan of improvement

Location and item	Length ^(a) (ft)	Top elevation (ft, msl)	Top width (ft)	Slope
<u>Shore and hurricane protection</u>				
Madison Township				
Beach fill, type A, 477,400 cu. yds.	2,583	15.0	50	1 on 20 and 1 on 15
Beach fill, type B, 207,100 cu. yds.	3,450	10.0	50	1 on 20
Beach fill, type C, 104,700 cu. yds.	2,767	5.5	150	1 on 20
Levees	1,940	15.0	25	1 on 3
<u>Shore protection</u>				
Matawan Township				
Beach fill, type B, 69,300 cu. yds.	1,700	10.0	50	1 on 20
Beach fill, type C, 107,700 cu. yds.	3,100	5.5	150	1 on 20
Borough of Union Beach				
Beach fill, type C, 130,600 cu. yds.	3,000	5.5	150	1 on 20
<u>Hurricane protection</u>				
Borough of Keansburg and East Keansburg				
Beach fill, type A, 2,514,900 cu. yds.	14,150	15.0	50	1 on 20 and 1 on 15
3 groins, 8,553 tons	260 ^(b)	0 to 5.5	8	1 on 1.5 and 1 on 2.5 ^(d)
Levees	13,290 ^(c)	15.0	8 to 25	1 on 3

(a) Includes lengths of raised road and bridges along centerline of proposed levees.

(b) Per groin.

(c) Includes portion with bulkhead and two railroad closure structures.

(d) Side slopes. The intermediate sloped section would be 1 on 15.

Table 8 - Estimated first cost broken down by principal features (dollars)

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>Including costs of preauthorization studies</u>					
<u>Federal first cost</u>					
1. Beach fill, 3,611,700 cu. yds.	648,000	160,000	120,000	1,916,000	2,844,000
2. Groins, 8,553 tons	0	0	0	148,000	148,000
3. Levees(a)	133,000	0	0	1,203,000	1,336,000
4. Preauthorization studies(b)	10,000	2,000	2,000	33,000	47,000
5. Engineering and design	23,000	2,000	1,000	141,000	167,000
6. Supervision and administration	63,000	13,000	10,000	272,000	358,000
Subtotal	877,000	177,000	133,000	3,713,000	4,900,000
Less local contribution(c)	392,000	129,000	112,000	1,017,000	1,650,000
Total Federal first cost	485,000	48,000	21,000	2,696,000	3,250,000
<u>Non-Federal first cost</u>					
7. Preauthorization studies	3,000	1,000	1,000	0	5,000
8. Cash contribution	389,000	128,000	111,000	1,017,000	1,645,000
9. Lands, easements and rights-of-way(d)	6,000	0	0	125,000	131,000
Total non-Federal first cost	398,000	129,000	112,000	1,142,000	1,781,000
Total first cost	883,000	177,000	133,000	3,838,000	5,031,000
<u>Excluding costs of preauthorization studies</u>					
Total Federal first cost	478,000	47,000	20,000	2,663,000	3,208,000
Percent of total first cost	55	27	15	70	64
Total non-Federal first cost	395,000	128,000	111,000	1,142,000	1,776,000
Percent of total first cost	45	73	85	30	36
Total first cost	873,000	175,000	131,000	3,805,000	4,984,000

(a) Includes costs of road and bridge raising, bulkhead, two railroad closure structures and interior drainage facilities.

(b) Includes Federal and non-Federal costs. The non-Federal portion of the costs of preauthorization studies is given in item 7.

(c) Includes non-Federal costs of preauthorization studies.

(d) Includes costs of buildings to be removed and allowances for contingencies, real estate planning expenses, administration, surveys and appraisals.

Table 9 - Summary of first cost broken down by shore and hurricane protection (dollars)^(a)

Section	Shore protection	Hurricane protection	Total
Madison Township	343,000	540,000	883,000
Matawan Township	177,000	0	177,000
Borough of Union Beach	133,000	0	133,000
Borough of Keansburg and East Keansburg	0	3,838,000	3,838,000
Total	653,000	4,378,000	5,031,000

(a) Includes costs of preauthorization studies.

Table 10 - Estimate of annual charges (dollars)^(a)

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>Shore protection</u>					
<u>Federal</u>					
Interest and amortization	3,700	1,700	800	0	6,200
<u>Non-Federal</u>					
Interest and amortization	8,500	4,700	4,000	0	17,200
Beach replenishment	8,500	6,800	4,100	0	19,400
Subtotal	17,000	11,500	8,100	0	36,600
49 Total shore protection	20,700	13,200	8,900	0	42,800
<u>Hurricane protection</u>					
<u>Federal</u>					
Interest and amortization	13,700	0	0	97,400	111,100
<u>Non-Federal</u>					
Interest and amortization	5,800	0	0	41,300	47,100
Maintenance and beach replenishment	3,500	0	0	49,900	53,400
Subtotal	9,300	0	0	91,200	100,500
Total hurricane protection	23,000	0	0	188,600	211,600
Total shore and hurricane protection	43,700	13,200	8,900	188,600	254,400
Rounded					254,000

(a) Includes costs of preauthorization studies.

101. Estimates of benefits. Benefits are anticipated from the proposed plan of improvement in the form of land to be saved from erosion; recreational benefits from additional beach use; decrease in maintenance costs of existing beach structures; prevention of erosion damage; and prevention of physical and non-physical primary damages from tidal flooding. Land enhancement benefits have not been evaluated since there would be little new or higher use of the land in the study area as a result of the construction of the proposed protective works. Most, if not all, of the enhancement of land values in the study area would be due to prevention of physical damage and improvement in conditions of beach use, benefits from which have been evaluated. Any additional benefits would be negligible. Evaluated annual benefits, which are based on May 1960 prices, total \$137,000 for shore protection and \$361,000 for hurricane protection. In addition, the plan of protection would reduce the possibility of loss of life such as occurred during past storms. A summary of benefits, broken down by shore sections and between shore protection and hurricane protection, is given in table 11. Details are contained in appendix K including breakdowns between public and private benefits from shore protection.

102. Justification of improvements. The estimated annual charges and benefits and benefit-cost ratio for the considered plan of improvement, broken down for shore protection and hurricane protection by shore sections, are given in table 12. It is to be noted that the improvements for shore and hurricane protection individually and where combined are economically justified. The benefit-cost ratio of the overall plan of improvement is 2.0.

XII. ALLOCATION AND APPORTIONMENT OF COSTS

103. Allocation of costs to purposes. The considered improvements for Matawan Township, Borough of Union Beach and Borough of Keansburg and East Keansburg are single-purpose improvements and the costs are entirely shore protection or hurricane protection. The costs for the multiple-purpose shore and hurricane protection improvement at Madison Township were allocated in accordance with the separable costs-remaining benefits method as described in detail in appendix J.

104. Apportionment of costs between interests. The apportionment of the first cost and annual charges of the considered improvement between Federal and non-Federal interests shown in tables 8 and 9 is based on present Federal law and policy governing beach erosion control and hurricane protection improvements. The basis for apportioning the costs for the two project purposes is described in the following paragraphs, under beach erosion control and hurricane protection, respectively. Details are given in section II of appendix J.

105. Beach erosion control. Apportionment of cost of beach erosion control improvements depends upon the Federal, non-Federal public and private interests in a shore protection project. The Federal interest is the benefit accruing to the United States as a landowner. No frontage is owned by the United States within the areas of the considered improvement.

Table 11 - Summary of estimated annual benefits (dollars)

Section and item	Shore protection	Hurricane protection	Total
<u>Madison Township</u>			
Land to be saved from erosion	2,900	-	2,900
Recreational benefit	69,500	-	69,500
Decreased maintenance of structures	2,200	-	2,200
Prevention of erosion damage	2,100	-	2,100
Prevention of damages from tidal flooding	-	34,800	34,800
Subtotal	76,700	34,800	111,500
<u>Matawan Township</u>			
Land to be saved from erosion	3,400	-	3,400
Recreational benefit	43,600	-	43,600
Decreased maintenance of structures	200	-	200
Prevention of erosion damage	1,600	-	1,600
Subtotal	48,800	-	48,800
<u>Borough of Union Beach</u>			
Land to be saved from erosion	2,000	-	2,000
Recreational benefit	8,800	-	8,800
Decreased maintenance of structures	800	-	800
Subtotal	11,600	-	11,600
<u>Borough of Keansburg and East Keansburg</u>			
Prevention of damages from tidal flooding	-	325,700	325,700
<u>All sections</u>			
Land to be saved from erosion	8,300	-	8,300
Recreational benefit	121,900	-	121,900
Decreased maintenance of structures	3,200	-	3,200
Prevention of erosion damage	3,700	-	3,700
Prevention of damages from tidal flooding	-	360,500	360,500
Grand total	137,100	360,500	497,600
Rounded	137,000	361,000	498,000

Table 12 - Economic justification

Section and item	Annual benefits (dollars)	Annual charges (dollars)	Benefit- cost ratio
<u>Madison Township</u>			
Shore protection	76,700	20,700	3.7
Hurricane protection	34,800	23,000	1.5
Subtotal	111,500	43,700	2.6
<u>Matawan Township</u>			
Shore protection	48,800	13,200	3.7
<u>Borough of Union Beach</u>			
Shore protection	11,600	8,900	1.3
<u>Borough of Keansburg and East Keansburg</u>			
Hurricane protection	325,700	188,600	1.7
<u>All sections</u>			
Shore protection	137,100	42,800	3.2
Hurricane protection	360,500	211,600	1.7
Grand total	497,600	254,400	-
Rounded	498,000	254,000	2.0

Non-Federal public interest is (a) the benefits accruing to a State or political subdivision thereof as a landowner, (b) the benefits accruing to the general public through use of the publicly-owned property, and (c) benefits from public use or the protection of nearby public property arising from protection of non-public shores. Data on the non-Federal public shores and the private shores publicly used which would benefit from the beach erosion control improvement are given in table J-15 of appendix J. Other benefits are considered to be private. The apportionment of costs for beach erosion control is based on present conditions of shore ownership and use. Final apportionment would be made on the basis of conditions of public use and ownership at the time of construction.

106. Under Public Law 826, 84th Congress, approved 28 July 1956, Federal contribution toward the cost of construction of protective works along publicly-owned shores is authorized up to one-third of the cost.

Shores other than public are eligible for Federal assistance if there is a benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project; the extent of Federal contribution depends upon the degree of such benefits but is also not to exceed one-third of the cost of the project. No Federal contribution is authorized towards shore protection maintenance work.

107. With regard to Federal participation in the cost of periodic beach nourishment, Section 1c of Public Law 828 reads as follows: "When in the opinion of the Chief of Engineers the most suitable and economical remedial measures would be provided by periodic beach nourishment, the term 'construction' may be construed for the purposes of this Act to include the deposit of sand fill at suitable intervals of time to furnish sand supply to project shores for a length of time specified by the Chief of Engineers." According to precedent established since the adoption of this law, Federal aid is not provided for periodic nourishment of a short beach compartment where the benefits are substantially confined within the compartment. Under this condition periodic nourishment is considered as maintenance. The shore segments proposed for improvement in the study area are relatively short compartments and significant benefits beyond the limits of the improvements are not expected. A discussion of the physical factors supporting this conclusion is presented in paragraph 77.

108. As indicated in paragraph 26, the State of New Jersey has requested reimbursement for beach erosion control work done by the State subsequent to initiation of the subject cooperative study. The State bases its request on the precedent established by Section 102 of Public Law 500, 85th Congress, approved 3 July 1958, which authorized reimbursement to local interests for such prior work done by them on specific beach erosion projects authorized in Section 101 of the same law, subject to the provision that the work which may have been done is approved by the Chief of Engineers as being in accordance with the adopted projects. In view of the fact that this law limits reimbursement to particular projects, enactment of new legislation would be required to make retroactive payment. The work in question involves beach fill which was placed in Keansburg in 1957. The extent of possible reimbursement to local interests by the Federal Government for the work, assuming that the precedent established by Section 102 of Public Law 500 would apply, is covered in supplement 2 of this report. The supplement includes an apportionment of the estimated first cost of a dual-purpose shore and hurricane protection improvement for Keansburg and East Keansburg with the work by the State included in the estimate. The supplement also includes an economic justification for the work.

109. Hurricane protection. Apportionment of the cost of hurricane protection is in accordance with the cost-sharing formula adopted in the Flood Control Act of 1958 for similar projects. It provides that first costs including the cost of lands, easements, rights-of-way, and relocations, but excluding the cost of preauthorization studies, shall be apportioned at least 30 percent to non-Federal interests and not to exceed

70 percent to the Federal Government. Lands, easements, rights-of-way, and relocations shall be provided by non-Federal interests without cost to the United States, and will be credited to the local contribution. When the fair value of these items is less than 30 percent of the first costs, the difference shall be borne by non-Federal interests as a cash contribution payable at the time of project construction. Maintenance costs shall be the responsibility of non-Federal interests.

110. In accordance with the foregoing the local share would include the costs of lands, easements, rights-of-way, and relocations and a cash contribution where those costs are less than 30 percent of the total first cost. The cost of maintenance of the beach fill, levees, interior drainage facilities and groins after construction would be assigned entirely to local interests.

XIII. COORDINATION WITH OTHER AGENCIES AND CONDITIONS OF LOCAL COOPERATION

111. Coordination with other agencies. The considered plan of improvement was coordinated with the United States Bureau of Public Roads, United States Public Health Service, United States Fish and Wildlife Service, New Jersey State Department of Conservation and Economic Development, New Jersey State Department of Health, New Jersey State Highway Department, Interstate Sanitation Commission and the Central Railroad of New Jersey. A number of meetings were held with State and local officials during the course of the investigation to obtain their views thereon. During a meeting on 18 December 1959, the engineering representative of the cooperating agency for the beach erosion study favored the preparation of a combined beach erosion and hurricane report for the study area. The aforementioned agencies are agreeable to the plan of improvement. Their views, which are summarized in the following paragraphs, are given in the statements contained in appendix M.

112. The United States Bureau of Public Roads indicated that any changes in construction on the Federal-aid system and in which the Bureau of Public Roads has participated, will be subject to the Bureau's approval after the State's approval.

113. The United States Public Health Service advised that it had reviewed the proposed project with the New Jersey Health Department which sees no reason why the plan should have any adverse effect on its water supply or pollution control program. In addition, the Public Health Service feels that the proposed improvement should be beneficial from the mosquito control standpoint.

114. The United States Fish and Wildlife Service made the following recommendations:

"(1) That whenever possible hydraulic fill be taken from continuous trenches with sloping sides and not isolated pits. Trenches should connect with deeper water whenever possible.

"(2) That these trenches be as deep as possible to minimize the loss to the shellfishery. A trench up to 40 feet deep having a minimum width of 150 feet and sloping sides should give the desired effects.

"(3) That silt from borrow pits be removed either to shore or to deeper waters to minimize siltation of adjacent shellfish."

It is anticipated that, in general, these recommendations can be implemented without any significant effect on the proposed improvement or its cost.

115. In letter dated 25 August 1960, the Bureau of Navigation of the New Jersey State Department of Conservation and Economic Development stated that the proposed plans of improvements were acceptable to local interests and that in the Department's view, the proposed work had been well conceived. This agency further stated that since the fulfillment of the conditions of local cooperation will require cooperation between all levels of local government, it cannot indicate at this time that the State would undertake to meet all of the conditions. On 29 November 1960, the Bureau of Navigation forwarded letters from the State Department of Health and State Highway Department. Both departments have no objections to the proposed improvements. The Interstate Sanitation Commission found the report to be a fair appraisal of the area.

116. The Central Railroad of New Jersey indicated that it had no objections to the proposed improvements, including the railroad stop-log structures, provided it is not assessed for a portion of the construction cost. It desired that detail plans and method of construction of the proposed railroad closure structures be subject to approval of its chief engineer.

117. Conditions of local cooperation. In accordance with Federal laws and policies, local interests would be required to bear 36 percent of the total first cost of the considered plan of improvement, a sum presently estimated at \$1,776,000 including an estimated \$131,000 for lands, easements and rights-of-way. Detailed conditions of local cooperation are listed in the section under "Recommendation".

118. As indicated in paragraph 26, local interests have requested that they be permitted to finance their share of the first cost on a long-term installment basis. There is no known precedent in this matter for shore or hurricane protection projects undertaken by the Federal Government. It is possible that the State of New Jersey may be willing to consider assisting the communities in such financing arrangements.

XIV. CONCLUSIONS

119. Erosion has reduced the width of beaches at a number of locations in the study area. As a result, public and private properties are subject to storm damage from wave attack. The eroded beaches are also inadequate to provide for the steadily increasing population which is creating a demand for additional recreational facilities.

120. Because of the especially low and flat terrain, several areas are vulnerable to severe tidal inundation during storms. This has resulted in substantial flood damages, loss of life and hardship to hundreds of families evacuated during time of storm.

121. It is concluded that the following improvements are economically feasible: (a) combined shore and hurricane protection at Madison Township; (b) shore protection at Matawan Township and Borough of Union Beach; and (c) hurricane protection at the Borough of Keansburg and East Keansburg. The improvements at Madison Township, Matawan Township and Borough of Union Beach may be undertaken independently, but the one at the Borough of Keansburg and East Keansburg should be accomplished as a unit. It is estimated that the time required for completion of all work involving beach fill, groins, levees and interior drainage facilities would be less than two years. Stability of the fill would be accomplished by periodic replenishment of losses as a maintenance feature. Further studies will be required to determine whether additional hurricane improvements may be economically feasible along Raritan and Sandy Hook Bays.

122. The improvement is amply justified by evaluated benefits. Possibility of reducing loss of life as a result of the plan of protection increases the justification. Adoption of a Federal project is advisable.

123. The total first cost of the considered improvement based on May 1960 prices is estimated at \$4,984,000, of which \$4,853,000 is for construction and \$131,000 is for lands, easements and rights-of-way involved in the hurricane protection phase of the improvement. The Federal share of the total first cost is 64 percent, presently estimated at \$3,208,000. These estimates exclude the costs of preauthorization studies amounting to \$47,000. Local interests would bear the entire cost of maintenance and beach replenishment for hurricane protection estimated at \$53,400 and the cost of beach replenishment for shore protection estimated at \$19,400 for a total of \$72,800 annually. Additional information on the project called for by Senate Resolution 148, 85th Congress, adopted 28 January 1958, is contained in supplement 1 to this report.

124. The shore protection portion of the beach fill completed by the State of New Jersey at the Borough of Keansburg in 1957 subsequent to initiation of the subject cooperative study has been found to be economically justified from a beach erosion control standpoint. Such work would have been included in the considered plan of improvement, if it had not been accomplished by local interests. Reimbursement by the United States of the cost of this shore protection work is found to be warranted, if Section 102 of Public Law 500, 85th Congress is to be considered as a precedent in this matter. In the event such reimbursement is approved, the Federal share of the cost of this work would be \$28,000 as given in supplement 2. This would be in addition to the Federal costs given in the preceding paragraph.

XV. RECOMMENDATIONS

125. The District Engineer recommends adoption of a project by the United States to provide for the following improvements as shown on plates 1A and 13 and figure J-1 of appendix J at a presently estimated total Federal first cost of \$3,208,000 (64 percent of the total first cost of the project) with such modifications as in the discretion of the Chief of Engineers may be advisable. The basis for determination of the Federal share of the cost is presented in paragraphs 104 to 106 and 109 and 110.

a. Madison Township. A combined shore and hurricane protection improvement providing for about 1.7 miles of beach fill at an elevation of 5.5, 10.0 and 15.0 feet above mean sea level; about 0.4 mile of levees at an elevation of 15.0 feet above mean sea level; and interior drainage facilities at a presently estimated Federal first cost of \$478,000 (55 percent of the first cost).

b. Matawan Township. A shore protection improvement providing for about 0.9 mile of beach fill at an elevation of 5.5 and 10.0 feet above mean sea level at a presently estimated Federal first cost of \$47,000 (27 percent of the first cost).

c. Borough of Union Beach. A shore protection improvement providing for about 0.6 mile of beach fill at an elevation of 5.5 feet above mean sea level at a presently estimated Federal first cost of \$20,000 (15 percent of the first cost).

d. Borough of Keansburg and East Keansburg. A hurricane protection improvement providing for about 2.7 miles of beach fill at an elevation of 15.0 feet above mean sea level; three groins; about 2.5 miles of levees at an elevation of 15.0 feet above mean sea level; and interior drainage facilities at a presently estimated Federal first cost of \$2,663,000 (70 percent of the first cost).

126. The District Engineer further recommends reimbursement to local interests for a portion of the cost of shore protection work accomplished by them in 1957 at the Borough of Keansburg. The Federal share of the cost of this work is \$28,000 which is in addition to the Federal cost given in the preceding paragraph.

127. Federal participation in the above work is recommended provided that, prior to initiation of construction, local interests give assurances satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

b. Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

c. Bear 36 percent of the total first cost, a sum presently estimated at \$1,776,000, to consist of the items listed in (a) and (b) above and a cash contribution now estimated at \$1,645,000, or, if any section is undertaken separately the apportionment of the first cost will be as shown in table 8, with due regard to change in public use and ownership and other changes prior to construction; provided that the cash contribution be paid either in a lump sum prior to commencement of the entire project, or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

d. Hold and save the United States free from damages due to the construction works;

e. Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

f. Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participation is based;

g. Control water pollution to the extent necessary to safeguard the health of bathers;

h. Obtain approval of the Chief of Engineers of detailed plans and specifications for the work contemplated and arrangements for its prosecution, prior to commencement of any work on the recommended beach protection improvements at Matawan Township and Borough of Union Beach or the beach protection phase of the project at Madison Township for which Federal participation is planned, if undertaken separately from the recommended combined improvement;

i. Contribute in cash toward the cost of hurricane protection works constructed under this plan, in addition to the apportionment required in (c) above, an amount equal to the increased Federal cost resulting from separate construction of the beach protection works at Madison Township referred to in item (h) above; and

j. Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms.

C. M. DUKE
Colonel, Corps of Engineers
District Engineer

[First endorsement]

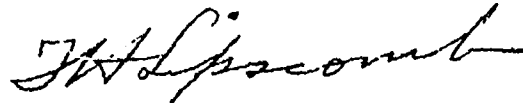
NADEN-R (30 Nov 60)

SUBJECT: Cooperative Beach Erosion and Interim Hurricane Study (Survey)
of Raritan Bay and Sandy Hook Bay, New Jersey

U. S. Army Engineer Division, North Atlantic, New York 7, N. Y.,
17 April 1961

TO: Chief of Engineers, Department of the Army, Washington 25, D. C.
ATTN: ENGCH-P

I concur in the recommendations of the District Engineer.



T. H. LIPSCOMB
Brigadier General, USA
Division Engineer

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
Information Called for by
Senate Resolution 148, 85th Congress
Adopted 28 January 1958

1. Plan of improvement. Erosion has reduced the width of beaches at a number of locations in the study area. As a result, public and private properties are subject to storm damage from wave attack. The eroded beaches are also inadequate to provide for the steadily increasing population which is creating a demand for additional recreational facilities. Because of the especially low and flat terrain, several areas are vulnerable to severe tidal inundation during storms. This has resulted in substantial flood damages, loss of life and hardship to hundreds of families evacuated during time of storm. The recommended improvement consists of: (a) combined shore and hurricane protection at Madison Township; (b) shore protection at Matawan Township and the Borough of Union Beach; and (c) hurricane protection at the Borough of Keansburg and East Keansburg. These improvements provide for beach fill, groins, levees and interior drainage structures. Stability of the fill would be accomplished by periodic replenishment of losses as a maintenance feature. The economic life of the improvement has been taken as 50 years.

2. First cost. The estimated first cost of the recommended improvements based on prices and conditions as of 1960 is given below. A breakdown of the estimates by sections is given in table 1.

Federal	\$3,208,000
Non-Federal	<u>1,776,000</u>
Total	\$4,984,000

3. Annual costs and benefits. The average annual economic costs and benefits for the recommended improvement, computed on the basis of an economic life of 50 years and an interest rate of 2-5/8 percent are given below. A breakdown by sections is given in table 2.

<u>Average annual costs</u>	<u>Federal</u>	<u>Non-Federal</u>	<u>Total</u>
Capital costs	\$117,300	\$ 64,300	\$181,600
Beach nourishment	0	49,900	49,900
Maintenance	0	22,900	22,900
Total	<u>\$117,300</u>	<u>\$137,100</u>	<u>\$254,400</u>

<u>Average annual benefits</u>	
Shore protection	\$137,100
Hurricane protection	360,500
Total	<u>\$497,600</u>

<u>Ratio of benefits to costs</u>	2.0
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4. The ratio of benefits to costs for an economic life of 100 years is 2.3. The higher value is due to the longer amortization period. The measures proposed will provide for present and reasonably prospective needs and will not preclude later modification or expansion should the need arise.

5. Allocation of costs. A summary of the results of allocation of costs of the recommended improvement between project purposes by the separable costs-remaining benefits, priority of use, and incremental cost methods are given below. It should be noted that the allocation obtained by use of the last two methods are identical. A breakdown of the allocation by sections is given in tables 3 and 4.

Item and purpose	Method of cost allocation	
	Separable costs- remaining benefits	Priority of use and incremental cost
<u>First costs:</u>		
Shore protection	\$ 653,000	\$ 699,000
Hurricane protection	4,378,000	4,332,000
Total	\$5,031,000	\$5,031,000
<u>Annual investment costs:</u>		
Shore protection	\$ 23,400	\$ 25,200
Hurricane protection	158,200	156,400
Total	\$ 181,600	\$ 181,600
<u>Maintenance and nourishment costs:</u>		
Shore protection	\$ 19,400	\$ 20,700
Hurricane protection	53,400	52,100
Total	\$ 72,800	\$ 72,800
<u>Total annual costs:</u>		
Shore protection	\$ 42,800	\$ 45,900
Hurricane protection	211,600	208,500
Total	\$ 254,400	\$ 254,400

6. Local cooperation. The apportionment of the first costs and annual charges of the recommended improvement between the Federal government and local interests is based on present law and policy governing beach erosion control and hurricane protection improvements. The recommended terms of local cooperation, based on allocation of costs by the separable costs-remaining benefits method, are as follows:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

b. Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

c. Bear 36 percent of the total first cost, a sum presently estimated at \$1,776,000, to consist of the items listed in (a) and (b) above and a cash contribution now estimated at \$1,645,000, or, if any section is undertaken separately the apportionment of the first cost will be as shown in the District Engineer's report, with due regard to change in public use and ownership and other changes prior to construction; provided that the cash contribution be paid either in a lump sum prior to commencement of the entire project, or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

d. Hold and save the United States free from damages due to the construction works;

e. Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

f. Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participation is based;

g. Control water pollution to the extent necessary to safeguard the health of bathers;

h. Obtain approval of the Chief of Engineers of detailed plans and specifications for the work contemplated and arrangements for its prosecution, prior to commencement of any work on the recommended beach protection improvements at Matawan Township and Borough of Union Beach or the beach protection phase of the project at Madison Township for which Federal participation is planned, if undertaken separately from the recommended combined improvement;

i. Contribute in cash toward the cost of hurricane protection works constructed under this plan, in addition to the apportionment required in (c) above, an amount equal to the increased Federal cost resulting from separate construction of the beach protection works at Madison Township referred to in item (h) above; and

j. Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms.

7. The recommended apportionment of first costs and annual charges based on the separable costs-remaining benefits method is given in table 5. A similar apportionment based on allocation by the priority of use and

incremental cost methods is given in table 6. A summary of the apportionment of costs by the above methods follows:

Item	Method of cost allocation	
	Separable costs- remaining benefits(a)	Priority of use and incremental cost
<u>First cost:</u>		
Federal	\$3,208,000 (64%)	\$3,189,000 (64%)
Non-Federal	1,776,000 (36%)	1,795,000 (36%)
Total	<u>\$4,984,000</u>	<u>\$4,984,000</u>
<u>Annual cost for nourishment and maintenance</u>		
Federal	0 (0%)	0 (0%)
Non-Federal	\$ 72,800 (100%)	\$ 72,800 (100%)
Total	<u>\$ 72,800</u>	<u>\$ 72,800</u>

(a) Recommended apportionment.

8. Discussion. The recommended project comprises a logical and economically justified means of providing shore protection and hurricane protection in the areas initially selected for detailed study. All other considered shore protection improvements in the study area were found to be economically unjustified with benefit-cost ratios substantially less than unity. Further studies will be required to determine whether additional hurricane improvements may be economically feasible along Raritan and Sandy Hook Bays.

Table 1 - First costs (dollars)^(a)

Section	Federal	Non-Federal	Total
Madison Township	478,000	395,000	873,000
Matawan Township	47,000	128,000	175,000
Borough of Union Beach	20,000	111,000	131,000
Borough of Keansburg and East Keansburg	2,663,000	1,142,000	3,805,000
Total	3,208,000	1,776,000	4,984,000

(a) Excludes \$47,000 for preauthorization studies of which \$42,000 is Federal and \$5,000 is non-Federal.

Table 2 - Annual costs and benefits (dollars)^(a)

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>Average annual costs</u>					
Federal					
Capital costs	17,400	1,700	800	97,400	117,300
Beach nourishment	0	0	0	0	0
Subtotal	17,400	1,700	800	97,400	117,300
Non-Federal					
Capital costs	14,300	4,700	4,000	41,300	64,300
Beach nourishment	9,800	6,800	4,100	29,200	49,900
Maintenance	2,200	0	0	20,700	22,900
Subtotal	26,300	11,500	8,100	91,200	137,100
Total annual costs					
Capital costs	31,700	6,400	4,800	138,700	181,600
Beach nourishment	9,800	6,800	4,100	29,200	49,900
Maintenance	2,200	0	0	20,700	22,900
Grand total	43,700	13,200	8,900	188,600	254,400
<u>Average annual benefits</u>					
Shore protection	76,700	48,800	11,600	0	137,100
Hurricane protection	34,800	0	0	325,700	360,500
Total	111,500	48,800	11,600	325,700	497,600
Ratio of benefits to costs ^(b)	2.6	3.7	1.3	1.7	2.0

(a) Includes preauthorization studies.

(b) Based on a 50-year life.

Table 3 - Allocation of costs by separable costs-remaining benefits method (dollars)^(a)

Item and purpose	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>First costs:</u>					
Shore protection	343,000	177,000	133,000	0	653,000
Hurricane protection	540,000	0	0	3,838,000	4,378,000
Total	883,000	177,000	133,000	3,838,000	5,031,000
<u>Annual investment costs:</u>					
Shore protection	12,200	6,400	4,800	0	23,400
Hurricane protection	19,500	0	0	138,700	158,200
Total	31,700	6,400	4,800	138,700	181,600
<u>Maintenance and nourishment costs:</u>					
Shore protection	8,500	6,800	4,100	0	19,400
Hurricane protection	3,500	0	0	49,900	53,400
Total	12,000	6,800	4,100	49,900	72,800
<u>Total annual costs:</u>					
Shore protection	20,700	13,200	8,900	0	42,800
Hurricane protection	23,000	0	0	188,600	211,600
Total	43,700	13,200	8,900	188,600	254,400

(a) Includes costs of preauthorization studies.

Table 4 - Allocation of costs by priority of use and incremental cost methods (dollars)^(a)

Item and purpose	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>First costs:</u>					
Shore protection	389,000	177,000	133,000	0	699,000
Hurricane protection	494,000	0	0	3,838,000	4,332,000
Total	883,000	177,000	133,000	3,838,000	5,031,000
<u>Annual investment costs:</u>					
Shore protection	14,000	6,400	4,800	0	25,200
Hurricane protection	17,700	0	0	138,700	156,400
Total	31,700	6,400	4,800	138,700	181,600
<u>Maintenance and nourishment costs:</u>					
Shore protection	9,800	6,800	4,100	0	20,700
Hurricane protection	2,200	0	0	49,900	52,100
Total	12,000	6,800	4,100	49,900	72,800
<u>Total annual costs:</u>					
Shore protection	23,800	13,200	8,900	0	45,900
Hurricane protection	19,900	0	0	188,600	208,500
Total	43,700	13,200	8,900	188,600	254,400

(a) Includes costs of preauthorization studies. The allocation of costs by either method yields identical results.

Table 5 - Recommended apportionment of costs (dollars)^(a)

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>First cost:</u>					
Federal	478,000 (55%)	47,000 (27%)	20,000 (15%)	2,663,000 (70%)	3,208,000 (64%)
Non-Federal	395,000 (45%)	128,000 (73%)	111,000 (85%)	1,142,000 (30%)	1,776,000 (36%)
Total	873,000	175,000	131,000	3,805,000	4,984,000
<u>Annual cost of maintenance and nourishment:</u>					
Federal	0	0	0	0	0
Non-Federal	12,000	6,800	4,100	49,900	72,800
Total	12,000	6,800	4,100	49,900	72,800

(a) Based on allocation by separable costs-remaining benefits method.
Excludes costs of preauthorization studies.

Table 6 - Apportionment of costs based on allocation by priority
of use and incremental cost methods (dollars)(a)

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
<u>First cost:</u>					
Federal	459,000 (53%)	47,000 (27%)	20,000 (15%)	2,663,000 (70%)	3,189,000 (64%)
Non-Federal	414,000 (47%)	128,000 (73%)	111,000 (85%)	1,142,000 (30%)	1,795,000 (36%)
Total	873,000	175,000	131,000	3,805,000	4,984,000
<u>Annual cost for maintenance and nourishment</u>					
Federal	0	0	0	0	0
Non-Federal	12,000	6,800	4,100	49,900	72,800
Total	12,000	6,800	4,100	49,900	72,800

(a) Excludes costs of preauthorization studies.

COOPERATIVE BEACH EROSION CONTROL AND INTERIM HURRICANE STUDY (SURVEY)
RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY

SUPPLEMENT 2

ANALYSIS OF REQUEST BY STATE OF NEW JERSEY FOR REIMBURSEMENT
OF COST OF BEACH FILL PLACED AT KEANSBURG IN 1957

1. General. This supplement analyzes the request by the State of New Jersey for reimbursement of the cost of the beach fill placed in the Borough of Keansburg in 1957. The request is presented and discussed in paragraphs 26 and 108 of the main report. The following paragraphs present an estimate, allocation, and apportionment of the first cost and annual charges of the considered plan of improvement for Keansburg and East Keansburg with the cost of the work by the State, which is considered to be reasonable, included in the estimates. It should be noted, that with the inclusion of the work by the State, the improvement is considered to serve the dual purposes of shore protection and hurricane protection. The beach erosion benefits resulting from the work by the State have been evaluated, and economic analyses have been made separately for each project purpose as well as for the entire improvement.

2. First cost. Table 1 gives an estimate of the first cost of the improvement broken down by project purposes. Under the criteria for cost allocation set forth in paragraph 12 of appendix J, it is considered that of the total of \$194,000 spent by the State, \$181,000 is a joint cost and \$13,000 is applicable to hurricane protection only. The remaining costs, detailed estimates of which are contained in appendix J, apply to the hurricane phase of the considered improvement.

3. Annual charges. The breakdown of annual charges by project purposes is given in table 2. The basis for these charges is discussed in paragraphs 13 and 15 of appendix J.

4. Annual benefits. Table 3 gives a summary of the \$70,400 shore protection benefit resulting from the considered plan broken down by shore ownership. It should be noted that all the shore along which the State placed fill is either publicly owned (41.3 percent of the frontage) or open to the public (58.7 percent of the frontage). The basis for estimating these benefits is the same as that used for the other areas covered in appendix K, and pertinent details are as follows. The land to be saved from erosion averages 0.3 acres annually with an estimated value of \$20,000 per acre. The recreational benefit is based on an estimated increase of 175,000 visits to the beach annually. It is estimated that about 6,000 feet of structures require less maintenance as a result of the improvement. A summary of all benefits totaling \$396,100 is given in table 4.

Table 1 - Summary of first costs for cost allocation by separable costs-remaining benefits method (dollars)

Item	Multiple-purpose project				Alternative single-purpose projects	
	Separable costs		Joint costs(a)	Total costs	Shore protection(b)	Hurricane protection(c)
	Shore protection	Hurricane protection(a)				
Beach fill placed by State in 1957	0	13,000(d)	181,000(d)	194,000(e)	181,000(d)	194,000
Construction cost of proposed additional hurricane protection	0	3,680,000(f)	0	3,680,000(f)	0	3,680,000
Lands, easements, and rights-of-way	0	125,000(g)	0	125,000(g)	0	125,000
Preauthorization studies	4,000(h)	33,000(h)	0	37,000	4,000	33,000
Total	4,000	3,851,000	181,000	4,036,000	185,000	4,032,000

(a) Based on consideration of the beach erosion single-purpose project as the joint cost and all other costs as being separable costs of hurricane protection.

(b) Based on a beach fill with a berm of 150 feet at 5.5 feet above mean sea level.

(c) Assumed the same as the multiple-purpose project, except for the cost of preauthorization studies.

(d) Of the 438,000 cubic yards of fill placed by the State at a cost of \$194,000, 408,000 cubic yards at a pro-rated cost of \$181,000 is considered to be the beach erosion single-purpose alternative and thus a joint cost as well. The balance of this work is considered to be hurricane protection only.

(e) The unit cost was less than the current Federal estimate for similar work.

(f) See table J-4 of appendix J.

(g) See table J-5 of appendix J.

(h) See table J-6 of appendix J.

Table 2 - Summary of annual charges for cost allocation by
separable costs-remaining benefits method (dollars)

Item	Multiple-purpose project				Alternative	
	Separable costs		Joint costs	Total costs	single-purpose projects	
	Shore protection	Hurricane protection			Shore protection	Hurricane protection
Investment	4,000	3,851,000	181,000	4,036,000	185,000	4,032,000
Interest and amortization ^(a)	100	139,200	6,500	145,800	6,700	145,700
Replenishment and maintenance	0	20,800 ^(b)	29,200 ^(c)	50,000	29,200 ^(c)	50,000
Total	100	160,000	35,700	195,800	35,900	195,700

(a) The interest and amortization charges are based on an interest rate of 2-5/8 percent and a useful life of 50 years (capital recovery factor .03614).

(b) Based on 0.5 percent of the first cost of the items requiring maintenance.

(c) Beach replenishment. For the basis of this item see table J-9 of appendix J.

Table 3 - Summary of estimated annual benefits
from shore protection (dollars)

Item	Public shore	Private shore open to the public	Total
<u>Land to be saved from erosion</u>			
Public benefit	3,000	0	3,000
Private benefit	0	3,000	3,000
Total	3,000	3,000	6,000
<u>Recreational benefit</u>			
Public benefit	25,300	36,000	61,300
Private benefit	0	0	0
Total	25,300	36,000	61,300
<u>Decreased maintenance of structures</u>			
Public benefit	1,200	1,300	2,500
Private benefit	0	600	600
Total	1,200	1,900	3,100
<u>All benefits</u>			
Public benefit	29,500	37,300	66,800
Private benefit	0	3,600	3,600
Total	29,500	40,900	70,400

Table 4 - Summary of estimated annual benefits from
shore and hurricane protection (dollars)

Item	Shore protection	Hurricane protection	Total
Land to be saved from erosion	6,000	-	6,000
Recreational benefit	61,300	-	61,300
Decreased maintenance of structures	3,100	-	3,100
Prevention of damages from tidal flooding	-	325,700	325,700
Total	70,400	325,700	396,100

5. Allocation and apportionment of costs. The allocation of costs between purposes by the separable costs-remaining benefits method is given in table 5. The first cost allocated to shore protection is \$94,000 of which \$4,000 is the cost of preauthorization studies. The Federal share of the cost is one-third of the cost of protecting the public shore plus one-third, adjusted by the ratio of public benefits to total benefits, of the cost of protecting the private shore open to the public. In this case, the Federal share would be $1/3 \times 41.3$ percent plus $1/3 \times 58.7$ percent $\times 37,300/40,900$, or 31.6 percent of the first cost. Applying this percentage to the \$90,000 construction cost allocated to shore protection yields a Federal contribution of \$28,000. Since there is no precedent for reimbursement to local interests for hurricane protection work accomplished prior to authorization of a Federal project, there would be no Federal contribution towards that portion of the State work allocated to hurricane protection. The Federal cost of hurricane protection for Keansburg and East Keansburg would be \$2,663,000 as given in table J-17 of appendix J.

6. Annual charges. Table 6 gives the estimated annual charges of the improvement broken down between shore and hurricane protection. It should be noted that all of the cost of beach replenishment would be a non-Federal cost as discussed in paragraph 107 of the main report. Table 6 also gives an economic analysis for both shore and hurricane protection alone and also combined.

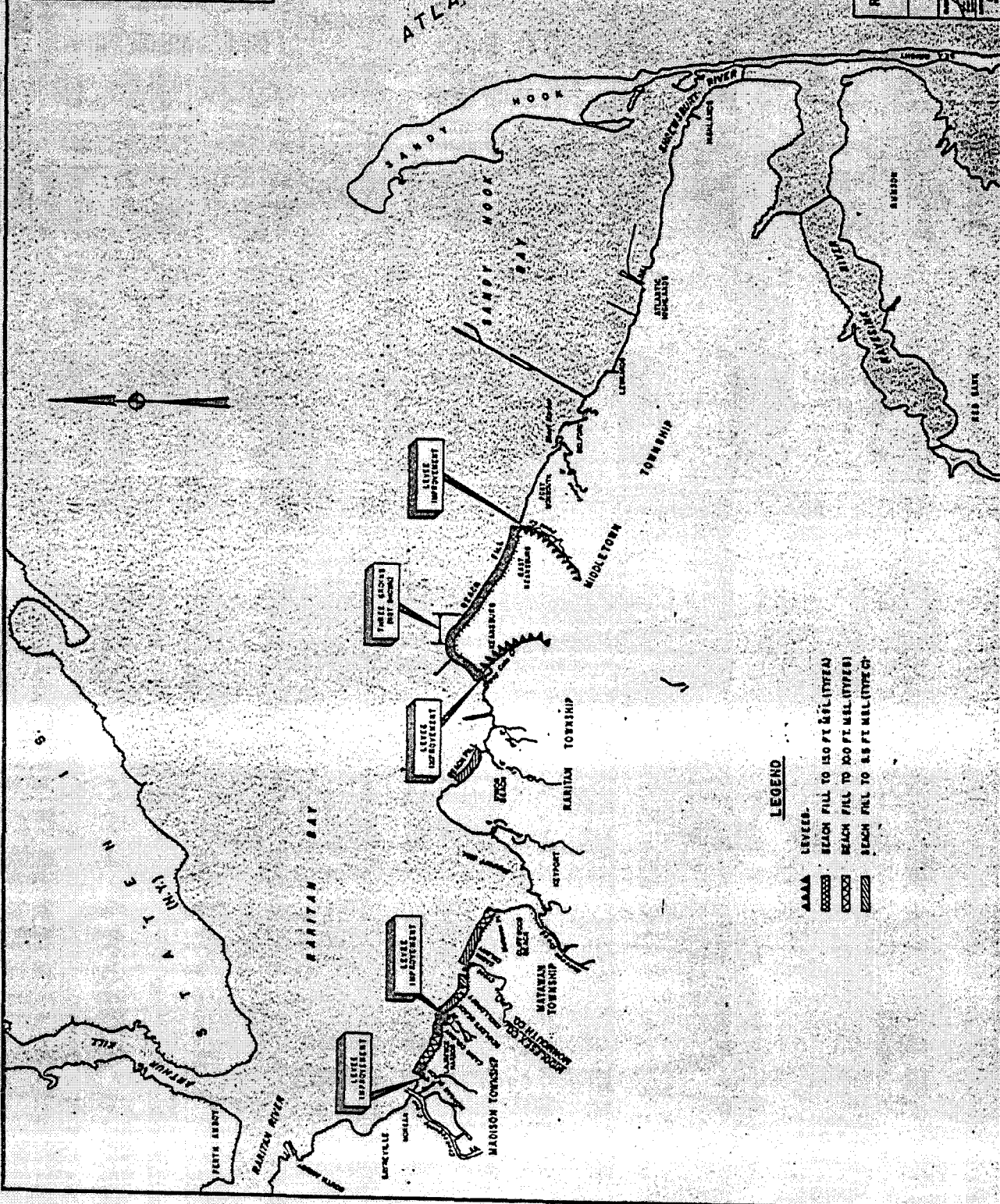
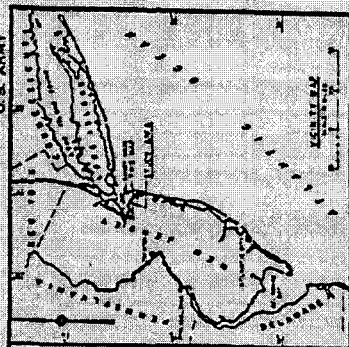
**Table 5 - Allocation of costs by method of separable
costs-remaining benefits (dollars)**

Item	Shore protection	Hurricane protection	Total
1. <u>Allocation of annual costs</u>			
a. Benefits	70,400	325,700	396,100
b. Alternative cost	35,900	195,700	231,600
c. Benefits limited by alternative cost	35,900	195,700	231,600
d. Separable cost	100	160,000	160,100
e. Remaining benefits (1c minus 1d)	35,800	35,700	71,500
f. Allocated joint cost (in proportion to 1e)	17,900	17,800	35,700
g. Total allocation of project costs (1d plus 1f)	18,000	177,800	195,800
2. <u>Allocation of nourishment and maintenance costs</u>			
a. Separable cost	0	20,800	20,800
b. Allocated joint cost (in proportion to 1e)	14,600	14,600	29,200
c. Total allocation (2a plus 2b)	14,600	35,400	50,000
3. <u>Allocation of investment</u>			
a. Annual investment cost (1g minus 2c)	3,400	142,400	145,800
b. Allocated investment (in proportion to 3a)	94,000	3,942,000	4,036,000
4. <u>Benefit-cost ratio</u>			
(1a divided by 1g)	3.9	1.8	2.0

Table 6 - Estimate of annual charges and economic analysis (dollars)

Item	Shore protection	Hurricane protection	Total
<u>Federal</u>			
First cost	28,000	2,663,000	2,691,000
Preauthorization studies	2,000	33,000	35,000
Total cost	30,000	2,696,000	2,726,000
Interest and amortization	1,100	97,400	98,500
Annual charges	1,100	97,400	98,500
<u>Non-Federal</u>			
First cost	62,000	1,246,000 ^(a)	1,308,000
Preauthorization studies	2,000	0	2,000
Total cost	64,000	1,246,000	1,310,000
Interest and amortization	2,300	45,000	47,300
Maintenance and beach replenishment	14,600	35,400	50,000
Annual charges	16,900	80,400	97,300
Total annual charges	18,000	177,800	195,800
Annual benefits	70,400	325,700	396,100
Benefit-cost ratio	3.9	1.8	2.0

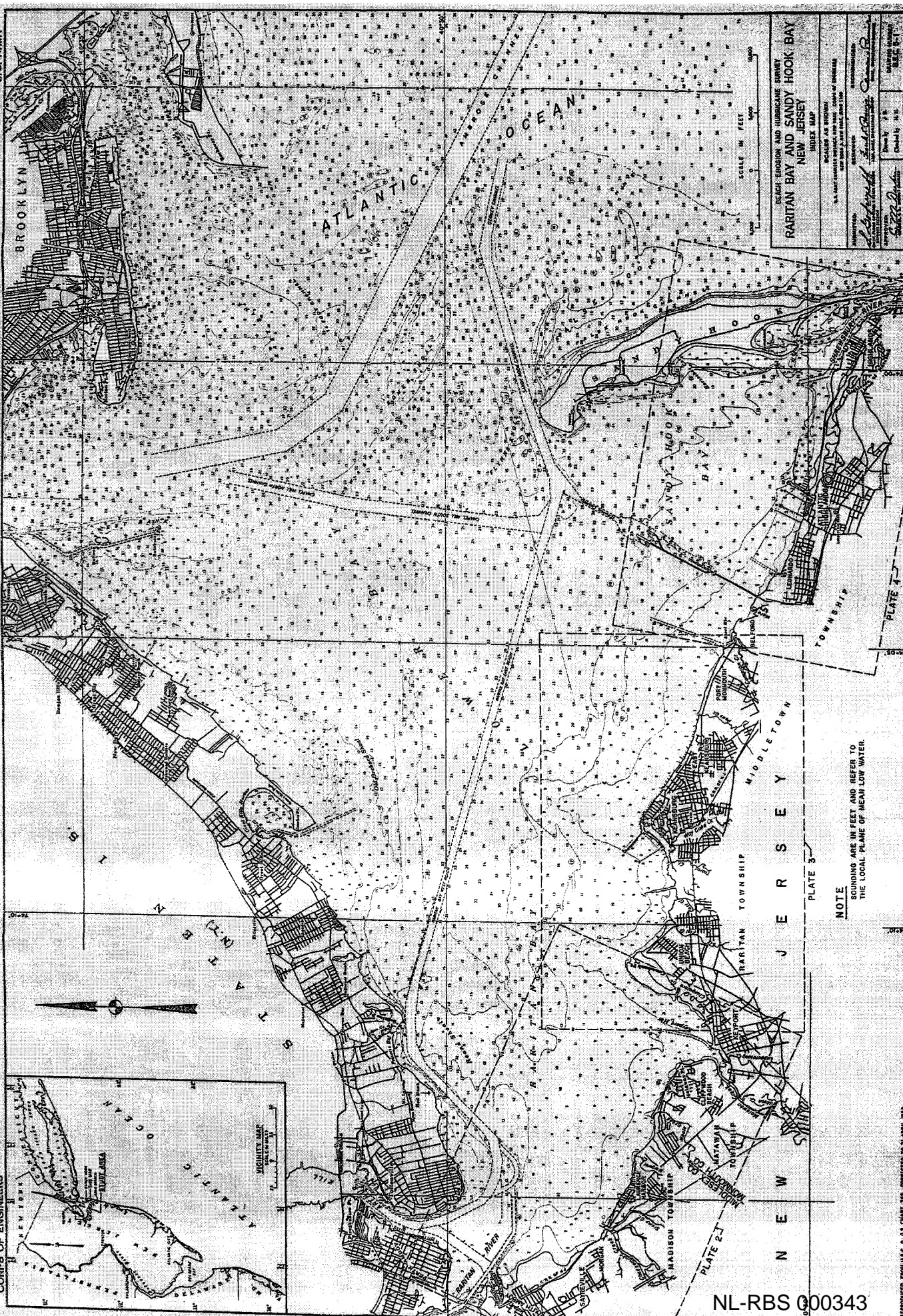
(a) Total cost of \$3,942,000 from table 5, less the Federal share of \$2,696,000.



RARITAN BAY AND SANDY HOOK BAY NEW JERSEY	
RECOMMENDED IMPROVEMENT	
SCALE OF MAP	
DATE OF MAP	
DRAWN BY	
CHECKED BY	
APPROVED BY	
PLATE 1A	

U.S. ARMY

CORPS OF ENGINEERS



INDEX MAP

SCALE: AS SHOWN ON MAP OF DISTRICT

U.S. ARMY ENGINEERING CORPS

REVISIONS

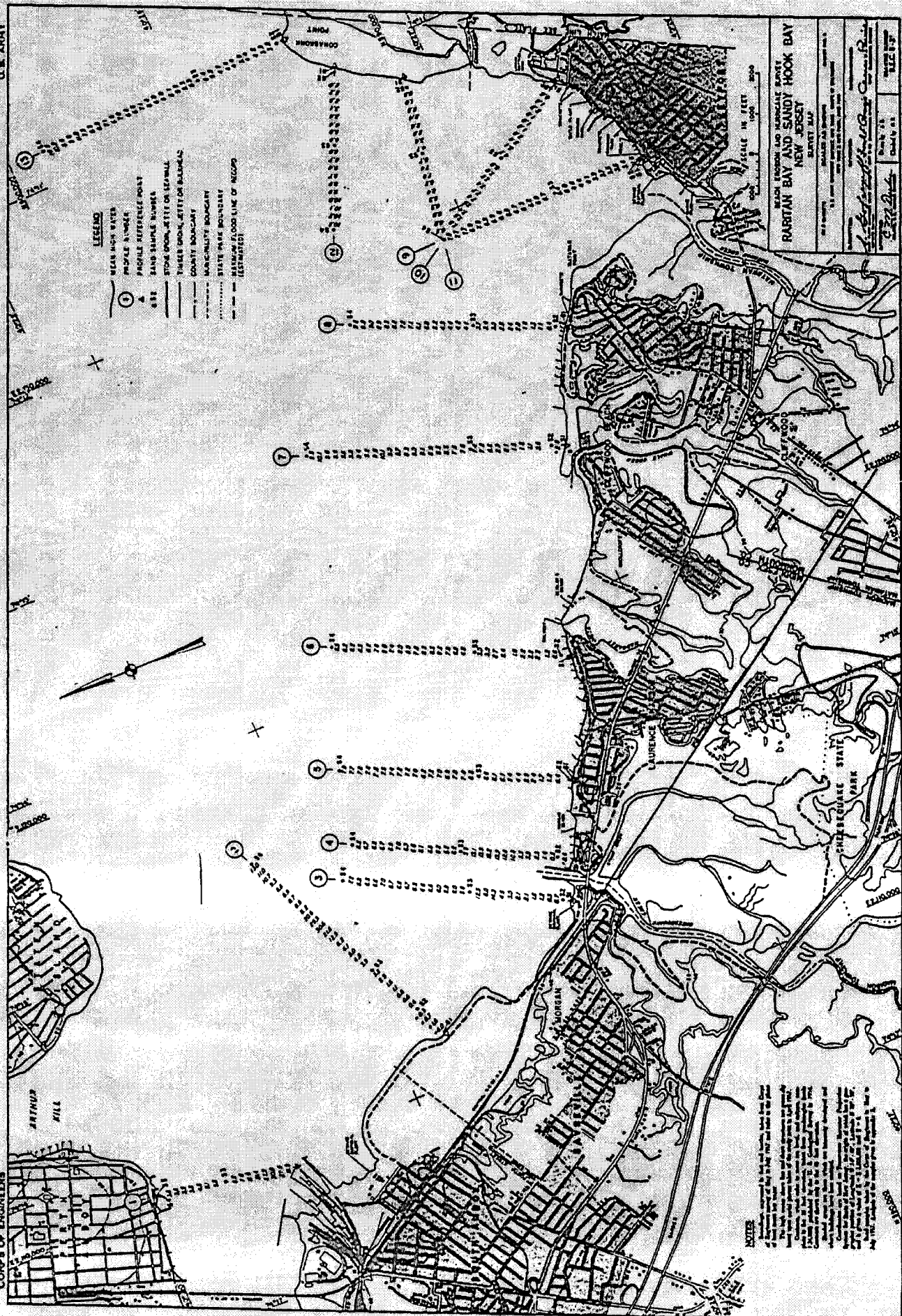
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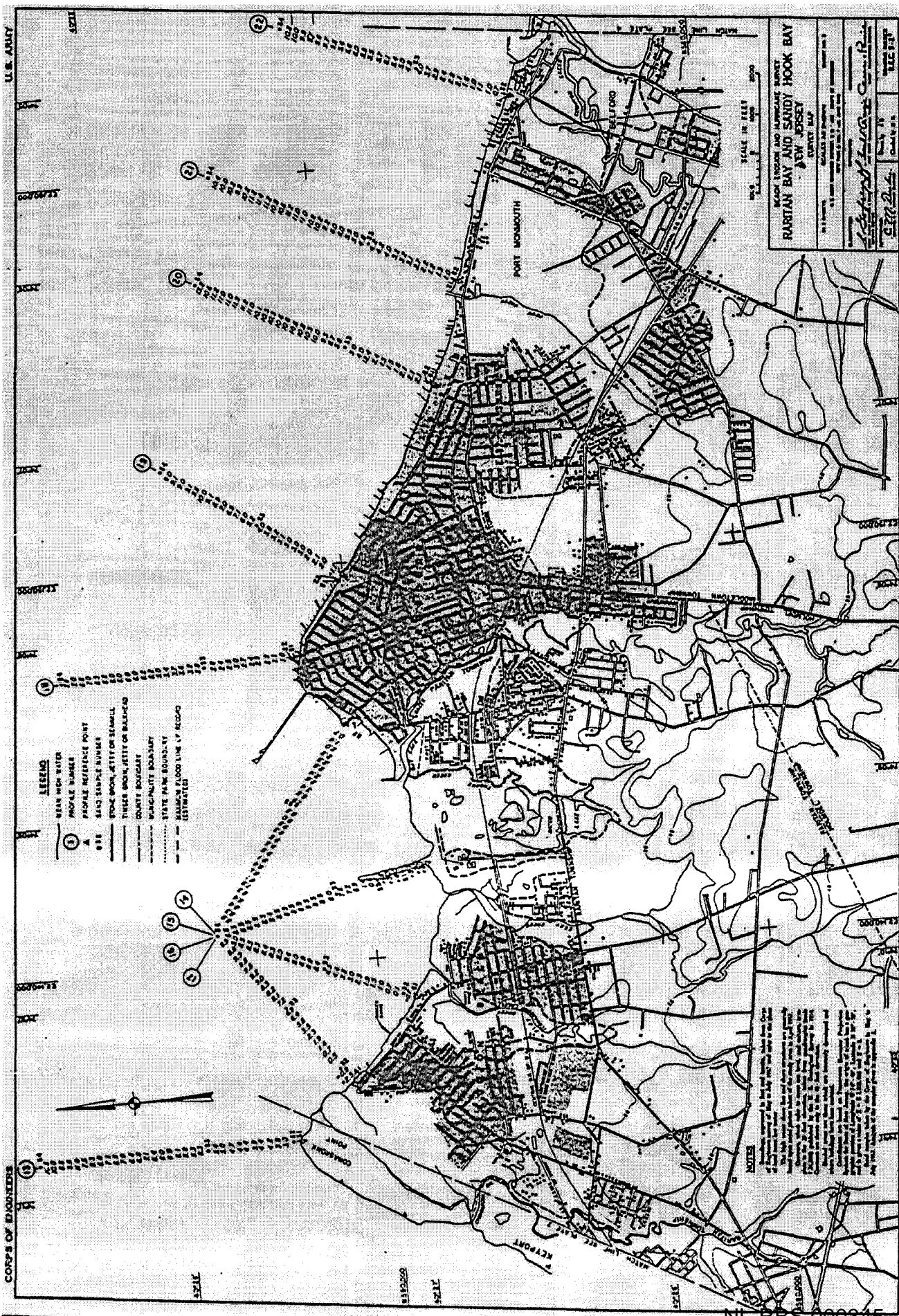
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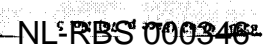
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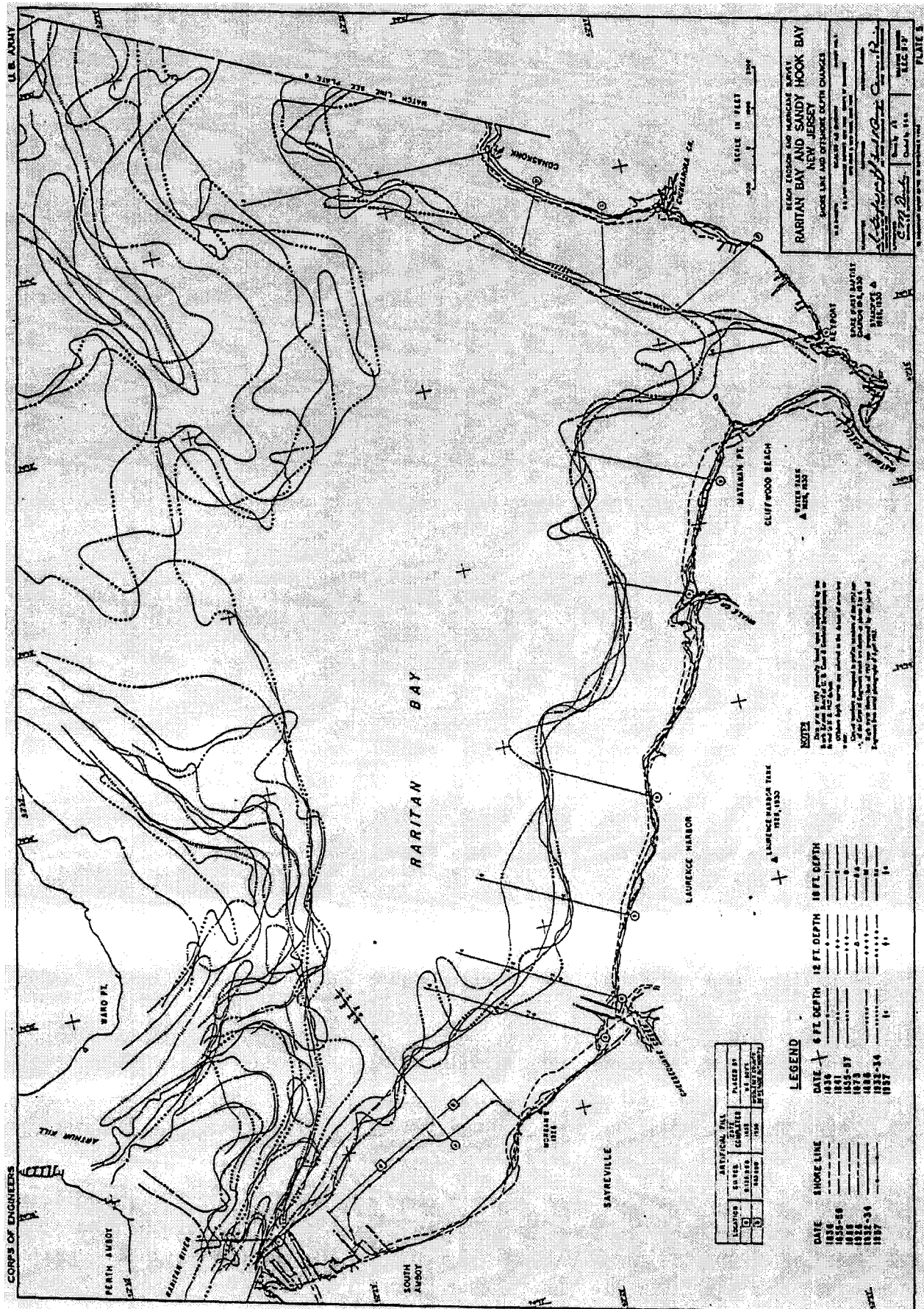
NOTE
SOUNDINGS ARE IN FEET AND REFER TO
THE LOCAL PLANE OF MEAN LOW WATER.

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COOPERATIVE BEACH EROSION CONTROL AND INTERIM HURRICANE STUDY (SURVEY)
RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY

APPENDIX A

GEOMORPHOLOGY AND LITTORAL MATERIALS

I. GEOMORPHOLOGY

1. General. The following geological information is generally based on data contained in "The Geology of New Jersey" prepared in 1914 by J. Volney Lewis and Henry B. Kümmel (revised and rewritten in 1938-40 by Henry B. Kümmel), and "Regional Study of Atlantic Coast of New Jersey", under preparation for publication by the Beach Erosion Board.

2. The study area lies within the Coastal Plain Province which forms the eastern margin of the State of New Jersey. Its surface has a gentle slope to the southeast, generally not exceeding 5 or 6 feet to the mile. The surface of the plain extends eastward with the same gentle slope beneath the Atlantic Ocean for about 100 miles to the end of the continental shelf, where the depth is approximately 100 fathoms. At this point, the ocean bottom drops abruptly to greater depths. The moderate elevation of the Coastal Plain, which rises to 400 feet in some areas but is generally lower than 200 feet, has prevented the streams from cutting valleys of any considerable depth. Throughout the greater portion of the plain, the relief is insignificant and the streams flow in open valleys that lie at only slightly lower levels than the broad, flat divides.

3. The subaerial portion. The study area, which is contained in Middlesex and Monmouth Counties, lies in that area of the Coastal Plain which is above the sea level. This subaerial portion is generally a dissected plain that rises gradually from sea level at the coast to nearly 400 feet in central New Jersey. It then declines to a broad shallow depression less than 100 feet above sea level extending to the Delaware River at Trenton. Some conspicuous features of the subaerial portion of the plain are the marshes which border the stream courses and the submerged or drowned valleys which were formed by erosion when the land was at a higher elevation than at present. During geologic history, the sea level fluctuated to a large extent. The rise and fall of the water resulted in a wide migration of the shoreline across the Coastal Plain. The subaerial region was especially influenced by these fluctuations during the Cretaceous Period.

4. The Cretaceous Period. The Cretaceous Period resulted in many successive sedimentary formations, each of which were subject to erosion, deposition, submersion and emergence. Realizing that all of New Jersey's geomorphology was determined by weathering and its associated agents, this geological period had great influence on the study area. The resulting

Cretaceous formations are composed of unconsolidated sand, clay and green-sand marl (glauconite), which dip 25 to 60 feet per mile to the southeast and have a thickness in places of 500 to 1,000 feet. The sediments rest on a sloping formation of deep seated hard rocks. The present surface features were most recently determined during the glacial Pleistocene Period and by subsequent erosion.

5. Subsurface geology. The subsurface geology of the Coastal Plain has been determined by study and correlation of well logs and by interpretation of seismic profiles. The Coastal Plain consists of Cretaceous to Recent sediments lapping on the basement material which is composed of crystalline rock with locally infolded or unfaulted Triassic sediments. The basement surface slopes at about 75 feet per mile, reaching a depth of more than 6,000 feet near the coast. A semi-consolidated sedimentary formation, varying in thickness to a maximum of about 13,000 feet, rests upon the basement material. An unconsolidated formation, which overlies the semi-consolidated material, consists of approximately equal thickness of the Upper Cretaceous and Tertiary sediments. The Cretaceous sediments are of prime importance in Raritan and Sandy Hook Bays area. The maximum thickness of the sediments (both Cretaceous and Tertiary) is about 4,800 feet near the edge of the continental shelf.

II. LITTORAL MATERIALS

6. General. Sand samples of bottom materials were taken by the U.S. Army Corps of Engineers in Raritan and Sandy Hook Bays in 1957. Generally, four samples were taken for each profile at mean high water, mean low water, about one-half mile offshore and about one mile offshore. The samples were analyzed for grain size distribution. The locations of the profiles and sand samples are shown on plates 2 to 4. In the following paragraphs the characteristics of these samples will be discussed. A tabulation of the statistical parameters used to characterize the sand samples is given in table A-1.

7. Characteristics. The statistical parameters used to characterize the sand samples were the median diameter and coefficients of sorting and skewness, all of which are derived from cumulative size distribution curves. The median diameter (M_d) indicates the mid-value of the grain diameters in millimeters, 50 percent of the total weight of a sample being composed of particles of smaller diameter and 50 percent of larger diameter particles. The coefficients of sorting (S_o), which indicates the degree of sorting of the material, is a function of the first quartile diameter (Q_1) and the third quartile diameter (Q_3) expressed as follows: $S_o = \sqrt{Q_3/Q_1}$. Twenty-five percent of the sample by weight has a grain diameter larger than the diameter of the first quartile (Q_1), while 75 percent of the sample has a diameter larger than the diameter of the third quartile (Q_3). A coefficient of sorting (S_o) equal to 1.25 is considered good sorting for samples of beach material, and about 1.5 for samples taken from the near-shore bottom. The larger values of coefficient of sorting indicate a more

poorly sorted material. The skewness, which indicates the symmetry of the grain size distribution, is derived from Trask's formula: $S_k = Q_1Q_3/M_d^2$. If the skewness is unity, the point of maximum sorting coincides with the median diameter. When it is greater than unity, the position of maximum sorting is on the fine side of the median diameter, and when it is less than unity, the position of maximum sorting lies on the coarse side of the median diameter.

8. Based on the results of the mechanical analyses of the bottom material sand samples, the study area may be divided into the following three reaches: Reach I, City of South Amboy to the Borough of Keyport (profiles 1 through 10); Reach II, Borough of Union Beach to Leonardo (profiles 11 through 24); and Reach III, Borough of Atlantic Highlands to Borough of Highlands (profiles 25 through 29). Within each reach the soil characteristics are generally of a similar nature.

9. Reach I. No definite trend in median diameter sizes is discernible from the mean high water samples in this reach. There are wide fluctuations of values between 0.26 mm at the Borough of Sayreville to 1.5 mm at Cliffwood Beach in Matawan Township. Generally, mud is encountered at mean low water over the western half of the reach from the City of South Amboy to Laurence Harbor in Madison Township. In the remainder of the reach, median diameter values of the mean low water samples average about 0.35 mm. The offshore samples are predominately mud at depths ranging from 3.6 to 15.0 feet below mean low water. Sand is encountered at about one-half mile offshore in the Cliffwood Beach area where median diameter sizes are approximately 0.25 mm.

10. In this reach, where median diameters show a general degree of variation, the coefficients of sorting and skewness show similar fluctuations. Both the mean high water and mean low water samples indicate poor sorting of beach material in this area. Peak values are 8.40 and 3.87 respectively for the coefficient of sorting, and 29.5 and 7.68 respectively for the coefficient of skewness. These high values of sorting coefficients indicate poor beach material with a general predominance of fine particles as shown by the high values of the coefficients of skewness. Some well sorted beach material is located approximately one-half mile offshore of the Cliffwood Beach area where the sorting values are essentially 1.25 and the skewness coefficients are about unity.

11. Reach II. Samples taken at mean high water and mean low water show a definite trend toward uniformity. The mean high water values of median diameters approximate 0.33 mm with very little variation from this value. The mean low water samples generally have larger median diameters of approximately 0.46 and show some variations from this value. The peak mean high water sample median diameter is 0.50 mm at profile 15 in the Borough of Union Beach, and the peak mean low water sample value is 1.15 at profile 22 in Belford. Slightly less than one-half of the offshore

samples are mud. Offshore samples in the eastern half of the reach indicate uniform characteristics up to one mile offshore, with the median diameter varying around 0.28 mm.

12. The coefficients of sorting and skewness show a marked degree of correlation with the median diameters. In this reach, the median diameters are relatively small and the coefficient of sorting fluctuates around its optimum value of 1.25, indicating well sorted material. The sand with small median diameters is generally well sorted. The coefficient of skewness is about unity over most of the reach.

13. Reach III. Soil characteristics in this reach are generally similar to those of Reach I. The median diameters show variations and no uniformity, ranging between 0.27 mm to 0.95 mm. The offshore samples are predominately mud.

14. The coefficient of sorting also shows large variations, but generally the sands in this reach have better sorting than those of Reach I. The maximum coefficients of sorting and skewness were obtained from the mean high water sample at profile 25 in the Borough of Atlantic Highlands, and are 5.00 and 10.2, respectively.

Table A-2 - Sand sample analyses

Location	Profile number	S ₁ (b)			S ₂ (c)			Sample number			S ₃			S ₄		
		M _d in mm	S _u	S _u	M _d in mm	S _u	S _u	M _d in mm	S _u	S _u	M _d in mm	S _u	S _u	M _d in mm	S _u	S _u
City of South Miami	1															
Borough of Sayreville	2	0.26	1.28	1.06	(d)						(d)			(d)		15.0
do.	3	0.58	3.28	2.16	(d)						(d)			(d)		7.3
Lawrence Harbor	4	0.44	3.54	3.13	(d)						(d)			(d)		7.4
do.	5	0.90	5.09	2.33	0.24	1.37	0.84				(d)			(d)		8.0
Lawrence Harbor in Madison Township	6	0.34	2.40	29.6	(d)			0.46	3.59	1.19	(d)			(d)		8.5
Cliffwood Beach in Madison Township	7	1.50	5.73	1.22	0.33	3.52	7.48	0.26	1.25	1.03	(d)			(d)		9.5
do.	8	0.53	5.16	9.48	0.22	3.02	5.40	0.24	1.26	0.99	(d)			(d)		9.5
Borough of Eggert	9	0.40	1.40	1.11	0.45	3.87	4.27				(d)			(d)		8.1
do.	10	0.44	2.35	2.40	(d)						(d)			(d)		8.1
Borough of Helen Beach	11	0.33	1.31	1.10	0.27	1.28	1.09				(d)			(d)		10.3
do.	12	0.39	1.30	1.06	0.49	1.56	1.24				(d)			(d)		12.8
do.	13	0.36	1.34	1.06	0.44	3.30	5.77	0.46	1.30	0.77	(d)			(d)		9.4
do.	14	0.32	1.27	0.98	0.22	1.19	1.06				(d)			(d)		9.4
do.	15	0.50	1.61	1.12	(d)						(d)			(d)		9.4
do.	16	(d)	(d)	(d)	0.28	1.20	0.97				(d)			(d)		9.4
Borough of Eastonburg	17	0.28	1.24	1.03	0.50	1.36	1.06				(d)			(d)		9.4
do.	18	0.29	1.17	1.01	0.29	1.29	1.14	0.29	1.20	1.09	(d)			1.17	1.01	8.0
do.	19	0.28	1.21	1.07	0.23	1.25	1.17	0.26	1.24	1.00	(d)			0.25	0.97	9.0
East Eastonburg	20	0.28	1.21	1.07	0.44	1.46	1.13	0.24	1.20	1.04	(d)			0.28	0.94	14.0
Port Harborth	21	0.31	1.34	0.98	0.75	1.32	1.32	0.25	1.23	0.94	(d)			0.28	1.19	12.0
Belmont	22	0.30	1.36	1.18	1.15	1.34	1.16	0.32	1.36	1.22	(d)			0.28	1.21	12.7
do.	23	0.30	1.27	1.11	0.26	1.21	1.04	0.30	1.24	1.06	(d)			0.28	1.20	11.0
Lawrence	24	0.28	1.10	0.96	0.60	1.78	1.07				(d)			(d)		15.8
Borough of Atlantic Highlands	25	0.50	5.00	10.2	0.95	3.74	2.86				(d)			(d)		16.7
do.	26	0.27	1.16	0.96	0.30	1.36	1.07				(d)			(d)		18.0
Borough of Highlands	27	0.13	1.25	1.08	0.25	1.22	1.04	0.41	1.32	1.11	(d)			1.15(d)	1.30(d)	
do.	27	1.05(b)(d)	2.44(b)(d)	2.15(b)(d)												
do.	28	(f)	(f)	(f)	(f)			0.52	1.31	1.04	(d)			1.75(e)	1.40(d)	
do.	28	1.02(b)(d)	1.31(b)(d)	1.03(b)(d)	0.74(c)(d)	1.57(c)(b)	1.07(c)(b)	0.70(b)(d)	1.30(b)(d)	1.04(b)(d)	(d)					
do.	29	(f)	(f)	(f)	(f)			0.30	1.16	1.01	(d)			0.48(d)	1.28(c)	0.93(d)
do.	29	0.38(b)(d)	1.15(b)(d)	1.08(b)(d)												

(a) Location of profiles and sand samples shown on plates 2 to 4.

(b) Samples taken at mean high water.

(c) Samples taken at mean low water.

(d) Mud.

(e) Brick fragments.

(f) No sample.

(g) Value is for 3-5.

(h) Value is for 3-4.

(i) Value is for 3-7.

COOPERATIVE BEACH EROSION CONTROL AND INTERIM HURRICANE STUDY (SURVEY)
RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY

APPENDIX B

LITTORAL FORCES

1. General. Waves, currents, winds, ice, and tides affect the movement of littoral materials. Data regarding these forces in the study area are presented in this appendix. Information on the effect of storms on the shore in the study area are contained in appendices C and K.

2. Waves. The study area is affected by both ocean waves entering the opening between Sandy Hook and Rockaway Point and by waves generated by local winds blowing across the open bay. Relatively little information is available on wave heights based on actual observations in the study area. However, estimates obtained from experienced seafaring personnel disclose that, after severe ocean storms, swells are as high as 15 feet between Sandy Hook and Rockaway Point. Storm wave heights of about 5 feet have been reported at Atlantic Highlands.

3. There are no wave gaging stations in the study area. However, a study of deep-water wave heights, frequency of occurrence, and direction of approach, based upon hindcasting technique and use of synoptic weather charts for the three-year period 1948-1950, was made by the Beach Erosion Board for the Atlantic Coast and published as Technical Memorandum No. 55. Graphs of wave heights for station C at the entrance to New York Harbor (lat. $40^{\circ}15'N$, long. $73^{\circ}45'W$) made in connection with this study revealed that 28 percent of the time, computed waves were 4 feet or greater in height, 9.5 percent 8 feet or greater, 2.0 percent 14 feet or greater, and only 1.0 percent of the time 18 feet or greater. The largest waves computed for this period were between 25 and 30 feet in height, but waves of this magnitude would be expected for a period of only 52 hours or during 0.2 percent of the period of observation. The duration of waves of particular height and direction were determined as a percentage of time for the entire year, and these values are shown graphically in the wave rose on plate 12. Since, on many occasions more than one wave train was present simultaneously, the sum of the percentages exceed 100.

4. Although for structural design purposes, the important factor is the size of the maximum wave height within a certain time period, calculations involving sand movement and littoral drift are best correlated with the amount of energy (potential) transmitted forward and onto the beach by the waves. A complete discussion of the method of calculating this energy and a table and graph of the resulting data for the station at the entrance to New York Harbor are given in the aforementioned Technical Memorandum No. 55. These data indicate that 50 percent of the energy comes from the east-northeast, 25 percent from the east and nearly all of the remainder from the quadrant between east and south.

5. All of the data shown in the tables and figures in Technical Memorandum No. 55 refer to deep-water conditions, that is, depths greater than one-half the wave length. As the waves enter Lower New York Bay, their characteristics are modified by the depth changes within the bay. In order to obtain data for the shallow inshore areas, use is normally made of refraction diagrams. However, since the effect of Ambrose Channel and other deep channels in Lower New York Bay, on wave refraction is unknown, no such diagrams were drawn for the study area.

6. Plate 12 also shows a wave diagram developed for the area off Point Comfort in Keansburg. This diagram was developed by using figure 10 of "Revisions in Wave Forecasting: Deep and Shallow Water" by C. L. Bretschneider, published in the Proceedings of the Sixth Conference on Coastal Engineering. The resulting wave heights were then modified by a refraction coefficient based on the estimated effect of refraction on the waves entering the opening between Rockaway Point and Sandy Hook. A study of the resulting diagram indicates that with a 40-mile per hour wind, waves can reach a height of 14 feet from the east-northeast direction. Waves generated from winds coming from outside the northeast to southeast quadrant will probably not exceed 6 feet.

7. In 1945, the firm of Frederic R. Harris, consulting Engineers, made a study of wave heights in the vicinity of the U. S. Navy pier at Leonardo in connection with a proposed breakwater. During the course of the study, tugboat men, dredge personnel and local boat owners were interviewed to obtain data on wave heights. The report states that 15-foot swells have been observed in the area between Sandy Hook and Rockaway Point and concludes that these swells would be reduced to a maximum of 6 feet in the area off the Navy pier.

8. Currents. According to the United States Coast and Geodetic Survey Tidal Current Tables, the currents in Raritan Bay and Sandy Hook Bay are generally weak, with the exception of the currents at the mouth of the Raritan and Shrewsbury Rivers. The average velocity at strength of current at the mouth of the Raritan River is 1.2 knots for the flood and 1.8 knots for the ebb. The corresponding values at the Highlands Bridge near the mouth of the Shrewsbury are 2.6 and 2.5 knots. About 1-1/2 miles north of Point Comfort the velocity at strength of the flood and ebb current is 0.6 knots.

9. Winds. The force of wind is a principal factor causing inundation of coastal areas and damage due to wave impact. High velocity onshore winds pile up water against the coast, causing abnormally high tidal levels resulting in inundation. Wind data are available from observations by the U. S. Weather Bureau at Sandy Hook, New Jersey and Long Branch, New Jersey, about 10 miles south of the eastern end of the study area. These data are presented in the following paragraphs. In addition, wind data obtained during storms are given in appendix C. Table B-1 summarizes data on maximum winds at Long Branch during recent storms. It should be noted that the highest recorded velocity of 78 miles per hour occurred during the northeaster of 6-7 November 1953.

Table B-1 - Wind data at Long Branch, N. J. during recent storms with maximum wind velocities 60 miles per hour or greater

Date of storm	<u>Maximum wind velocity</u>		Type of record
	Miles per hour	Direction	
21 September 1938*	60	NW	5-minute average
3 March 1942	60	NE	5-minute average
26 October 1943	60	NE	5-minute average
14 September 1944*	74	N	5-minute average
22-29 November 1945	68	NE	5-minute average
25 November 1950	70	SE	fastest mile
6-7 November 1953	78	E	fastest mile
31 August 1954*	60	NW	fastest mile
6-7 October 1957	63	NE	fastest mile
18-19 February 1960	72	NE	fastest mile
12 September 1960*	72	NE	fastest mile

*Denotes hurricane, the other storms are northeasters.

10. A study of the wind diagram for Sandy Hook for the period 1924 to 1934 given on plate 12 reveals that the prevailing winds with a total duration of almost 20 percent are from the northwest and that winds from the north and northeast each occur slightly more than 15 percent of the time. This diagram also indicates that 4 out of a total of 11 wind observations over 50 miles per hour were from the northeast and 5 of the remaining were in the south and southwest quadrants.

11. Diagrams showing prevailing winds as compiled from records of the U. S. Navy Hydrographic office for the 5° squares nearest the entrance to New York Bay are shown on plate 12. These diagrams show that the winds in the quadrant between north and west prevail, which is in agreement with the records for Sandy Hook.

12. Ice conditions. During the winter, ice usually forms in Sandy Hook Bay in the area immediately west of Sandy Hook and during several winters, broken ice from the Raritan River has flowed into Raritan Bay. However, there are no known problems due to ice conditions along the frontage of the study area.

13. Tides. Tides along the study area are semi-diurnal and have a mean range varying from 5.0 feet at South Amboy to 3.8 feet at Highlands near the mouth of the Shrewsbury River. The spring range varies from 6.0 feet to 4.6 feet at the respective locations.

14. Table B-2 shows the extreme tidal heights and maximum storm surges along the study area during the storms of 21 September 1938, 14 September 1944, 25 November 1950, 6-7 November 1953, 31 August 1954, 14 October 1955, and 12 September 1960. It should be noted that the maximum of record storm water elevation in the immediate vicinity of the study area was recorded at 9.48 feet above mean sea level by the Perth Amboy tide gage during the storm of 25 November 1950. The maximum storm surge for this storm was 10.4 feet. Figure H-1 of appendix H shows a stage history of this storm tide. It is estimated from high water marks that the water level at Perth Amboy during the hurricane of 12 September 1960, (Donna) exceeded that of the 1950 storm by about 0.5 foot.

15. The estimated frequency of high tides in the study area is shown on figure K-1 of appendix K. Abnormally high tides are generally accompanied by strong winds and high waves which, due to the increased water depth, break much further inshore than usual. The foregoing together with the increase in normal sea level at a rate of about 2 feet per century (see paragraph 35 and figure K-2 of appendix K), results in a greater amount of wave energy being expended higher upon the beaches and adding to the factors conducive to storm damage.

Table B-2 - Tidal heights and storm surges for severe storms

Station	Maximum observed tide			Maximum storm surge		
	Time	Observed tide	Height above predicted tide(a)	Time	Height above predicted tide(a)	Observed tide
	(EST)	(ft. msl.)	(ft.)	(EST)	(ft.)	(ft. msl.)
<u>TIDE GAGE RECORDS</u>						
<u>Perth Amboy</u>						
21 Sept. 1938	1630	6.6	4.1	1630	4.1	6.6
14 Sept. 1944(b)	2040	7.4	5.5	2040	5.5	7.4
25 Nov. 1950	0915	9.48	6.8	1510	10.4	7.7
6-7 Nov. 1953	0630	8.88	6.6	1500	6.7	7.2
31 Aug. 1954	0930	5.81	2.7	1600	4.7	2.35
14 Oct. 1955	1815	7.7	4.9	1700	5.7(d)	7.25
12 Sept. 1960	-	10.0(d)	-	-	7.5(d)	-
<u>Sandy Hook</u>						
21 Sept. 1938	1550	5.85	3.8	1550	3.8	5.85
14 Sept. 1944(b)	2000	7.4	5.2	2000	5.2	7.4
25 Nov. 1950	0800	7.2	4.5	1600	8.7	7.0
6-7 Nov. 1953	0700	7.9	5.2	0500	5.8	6.5
31 Aug. 1954	0900	6.4	3.8	0900	3.8	6.4
14 Oct. 1955	1800	6.2	3.6	1600	3.9	4.6
12 Sept. 1960	-	8.6(d)	-	-	6.0(d)	-
<u>HIGH WATER MARK MEASUREMENTS(c)</u>						
<u>South Amboy</u>						
25 Nov. 1950		9.5				
<u>Cheesequake Creek</u>						
12 Sept. 1960		9.8				
<u>Borough of Keyport</u>						
14 Sept. 1944		8.4				
25 Nov. 1950		9.1				
12 Sept. 1960		10.3				
<u>Borough of Keansburg</u>						
14 Sept. 1944		8.4				
25 Nov. 1950		9.1				
<u>Borough of Highlands</u>						
21 Sept. 1938		6.3				
14 Sept. 1944		8.4				
25 Nov. 1950		6.8				
12 Sept. 1960		9.6				

(a) Storm surge (observed tide minus predicted tide,.

(b) Eastern War Time used for this storm.

(c) May include wave uprush.

(d) Estimated; not from tide gage record.

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APPENDIX D

SHORE LINE CHANGES, OFFSHORE DEPTH CHANGES, PROFILES,
AND VOLUMETRIC ACCRETION AND EROSION

1. Introduction. This appendix presents data pertaining to the following items: (a) shore line changes, (b) offshore depth changes, (c) profiles, and (d) volumetric accretion and erosion. The data are based generally on high water shore lines obtained from surveys made by the U. S. Coast and Geodetic Survey in 1836, 1841, 1855-56, 1886, 1926 and 1932-34; from hydrographic surveys made by the same agency in 1836, 1841, 1855-57, 1873, 1886 and 1932-34; and from a survey made by the Corps of Engineers in 1957 along selected profiles, supplemented by use of aerial photographs taken the same year for locating the shore line between profiles. (See plates 5 through 10).

2. Due to the scale (1:10,000) used on available maps, it is difficult to measure small changes with accuracy. Therefore, descriptions of changes contained in the following paragraphs have been limited to those large enough to permit measurement. Because of the irregular manner in which many of the changes have occurred, no attempt has been made to describe them in detail. The changes described can generally be considered accurate in indicating the trend in the area and only approximate with respect to the actual quantitative change.

I. SHORE LINE CHANGES

3. General. Examination of the shore line changes (plates 5 through 7) suggests a division of the study area into four reaches. Reach I, which has a general history of erosion with some considerable localized accretion, extends from South Amboy to Cheesequake Creek. Reach II extending from Cheesequake Creek to Matawan Creek also shows a general erosional trend. Reach III from Matawan Creek to Compton Creek is characterized by heavy erosion. Reach IV extending from Compton Creek to the Shrewsbury River shows a history of slight erosion. A summary of the average shore line changes in the four reaches is given in table 6 of the main report.

4. South Amboy to Cheesequake Creek (Reach I). This 2.1-mile reach experienced its great shoreward movement during the period 1836 to 1855-56. The western portion of the reach eroded an average of 110 feet along one-half mile of shore, with maximum erosion reaching 200 feet. In the center of the reach, a one-quarter mile section near Morgan also experienced an average erosion of 110 feet, but the maximum erosion was 260 feet. The eastern half of the reach was characterized by severe erosion for approximately three-quarters of a mile west of Cheesequake Creek, reaching an average shore line

recession of 310 feet and a maximum of 450 feet. The average annual erosion in the latter section was 16 feet, or twice the average for the entire reach. From 1855-56 to 1886 the reach remained relatively stable with some localized erosion in the central portion and accretion just west of Cheesequake Creek.

5. The period from 1886 to 1926 showed an average annual accretion over the area of about 1 foot. The western half of the reach experienced no appreciable shore line change, however near Morgan there was an area of accretion averaging about 150 feet and a smaller area of erosion to the east, averaging about 100 feet. The west jetty at Cheesequake Creek, which was constructed in 1883, started to trap littoral material during this period with a total accretion averaging 240 feet and a maximum accretion of 550 feet near the jetty. From 1926 to 1932-34 the average annual erosion in the reach was about 2 feet. However, accretion continued at the west jetty of Cheesequake Creek and averaged about 220 feet along a 1,000-foot shore front with a maximum build-up of 600 feet along the jetty.

6. The period 1932-34 to 1957 was marked by major changes in the shore line due to placement of artificial fill by the U. S. Government (6,135,000 cubic yards in 1953) and by the Middlesex County Sewerage Authority (583,000 cubic yards in 1956) in locations [a] and [b] shown on plate 5. This caused the reach to have a total average accretion of 810 feet and an average annual accretion of 34 feet. The only erosional effect during this period was immediately west of Cheesequake Creek where the shore receded about 70 feet. The 121-year record covering the period 1836 to 1957 showed a total average high water shore line accretion of 680 feet with an average annual accretion of 5.6 feet.

7. Cheesequake Creek to Matawan Creek (Reach II). During the period from 1836 to 1855-56 this reach, which covers 3.5 miles of frontage, was generally an eroding shore with an average annual erosion of about 5-1/2 feet. The Laurence Harbor frontage experienced an average shore line recession during this period of about 140 feet, or approximately 7 feet per year; maximum erosion was about 300 feet. At Matawan Point there was severe bluff erosion for more than a mile of shore, averaging about 220 feet with a maximum shore line recession of 350 feet. Local accretion is indicated just west of Matawan Creek averaging about 250 feet. The overall trend of the reach during the period 1855-56 to 1886 was one of accretion, averaging about 1 foot per year. Local areas experienced accretion and erosion to varying degrees. Total accretion at Matawan Creek averaged 250 feet. Erosion in the Laurence Harbor area averaged about 130 feet along approximately one-half mile of frontage, with maximum recession of about 150 feet.

8. The period 1886 to 1926 was also marked by a general seaward movement of the shore line, averaging about 1 foot per year. There was accretion behind the east jetty at Cheesequake Creek and an extremely heavy accumulation of material on the west bank of Whale Creek which extended the bank about 750 feet seaward of its 1886 position. This accumulation accounted for

an average accretion in the area of 310 feet. Erosion during this period averaged about 100 feet at Cliffwood Beach and in the vicinity of Matawan Creek. The period 1926 to 1932-34 was one of slight erosion in this reach, averaging 1 foot per year.

9. Between 1932-34 and 1957 there were local seaward and landward shore line movements generally averaging 50 to 100 feet. During this period portions of the shore between Laurence Harbor and Whale Creek receded 100 to 300 feet. From Whale Creek east to Matawan Creek the 1957 shore was generally about 100 feet seaward of the 1932-34 shore line. For the 1836-1957 period the high water shore line showed a total average erosion of 55 feet with an average annual erosion of 0.5 foot.

10. Matawan Creek to Compton Creek (Reach III). This reach, which is approximately 9 miles long, experienced its greatest period of erosion during 1836 to 1855-56. From Matawan Creek to Conaskonk Point the shore line showed only minor changes except for local erosion in a zone 1,500 feet long from the mouth of Chingarora Creek northward. From Conaskonk Point to Way Cake Creek the average annual recession was about 11 feet with the maximum total erosion reaching 500 feet at several locations. Severe shore line recession was also experienced from Way Cake Creek to Pews Creek, averaging about 200 feet along a 3-mile stretch with a maximum of 450 feet west of Point Comfort. Between Pews Creek and Compton Creek the erosion averaged 130 feet and reached a maximum of 350 feet on the west bank of Compton Creek. The average annual erosion for the entire reach was about 8 feet. The period 1855-56 to 1886 was marked by a negligible high water shore line change, however, accretion was noted especially in the areas near Chingarora Creek and Conaskonk Point where the seaward movements ranged up to 300 feet, and between Flat Creek and Way Cake Creek where it reached a maximum of 600 feet. General recession occurred between Keyport and Conaskonk Point, and from Way Cake Creek to Pews Creek. A maximum recession of 250 feet occurred at Keansburg.

11. Shore line changes in the reach between 1886 and 1926 show general erosion except for an average seaward movement of the shore line of 90 feet between Flat Creek and Way Cake Creek. An average recession of 90 feet occurred between Point Comfort and Pews Creek. The overall average annual shore line recession for the entire reach was about one-half foot during the period. From 1926 to 1932-34 the reach was marked by a general seaward movement of the shore line with an average movement of about 500 feet along the one-half mile shore immediately west of Way Cake Creek. The average annual accretion for the entire reach was about 2-1/2 feet.

12. The period 1932-34 to 1957 was characterized by a very slight average annual shore line recession. The recession averaged 95 feet near Conaskonk Point and between Flat Creek and Way Cake Creek. The seaward movement of the shore line noted between Way Cake Creek and Pews Creek is a result of artificial fill, totaling 318,000 cubic yards, placed during this period in this area (see locations [c] through [g] on plate 6). For

the entire reach between Matawan Creek and Compton Creek, the 121-year record covering the period 1836 to 1957 showed a total average high water shore line erosion of 154 feet with an average annual erosion of 1.3 feet in spite of beach fill placed in the reach.

13. Compton Creek to Shrewsbury River (Reach IV). During the period from 1836 to 1855-56 this reach, which is approximately 7 miles long, experienced its greatest erosion, averaging about 2-1/2 feet per year. The eastern portion of the reach generally eroded more than 100 feet, with the maximum erosion along the Highlands area reaching 650 feet. East of this area accretion reached 300 feet. In 1836 the Shrewsbury River emptied into the Atlantic Ocean and Sandy Hook was joined to the Highlands. By 1855-56 the Shrewsbury River flowed into Raritan Bay and Sandy Hook was attached to the Atlantic coastal barrier beach. The period 1855-56 to 1886 showed an overall negligible effect on the high water shore line, with the exception of a portion of Atlantic Highlands at the mouth of Shrewsbury River where the shore receded 50 to 100 feet. Accretion reached a maximum of 400 feet west of the Highlands.

14. From 1886 to 1926 and 1926 to 1932-34 there was a general overall erosional effect although the changes were minor. No distinct trend was evident.

15. Between 1932-34 and 1957 many changes occurred in the shore line. East of the jetty at Compton Creek the high water line has moved seaward as much as 300 feet, partially attributed to the placement of 100,000 cubic yards of artificial fill completed in 1956 by the U. S. Government. Starting about 900 feet east of the jetty and extending for about 1.5 miles the shore has eroded an average of 170 feet. The remaining shore line to Highlands shows accretion except for a 1,200-foot frontage in Highlands at the mouth of Shrewsbury River where there was localized erosion. The areas where maximum seaward movements occurred coincide with a number of recent artificial fill projects involving a total of 792,000 cubic yards (see locations [1] through [1] on plate 7). The 121-year record covering the periods 1836 to 1957 showed a negligible total high water shore line change.

II. OFFSHORE DEPTH CHANGES

16. General. Changes in the positions of the 6, 12 and 18-foot depth contours were determined by the superposition of hydrographic surveys of the U. S. Coast and Geodetic Survey as shown on plates 5 through 7. Examination of the changes since 1836 indicate both offshore and onshore movement with no apparent consistency. The changes during the various periods between surveys are described in the following paragraphs.

17. 1836 to 1841. This period was marked by a general offshore movement for the 6, 12 and 18-foot contours. Among the maximum offshore movements were the following: for the 6-foot contour, 1,600 feet, near Cheesequake Creek; for the 12-foot contour, 1,500 feet, off Cliffwood Beach and 2,800 feet, off Conaskonk Point; and for the 18-foot contour, 4,000 feet, offshore of Atlantic Highlands.

18. 1841 to 1855-57. In this period the 6, 12 and 18-foot contours generally moved onshore reversing the trend of the previous 5-year period. The notable exception to this trend occurred in the vicinity of Point Comfort in Keansburg where the 12 and 18-foot contours moved 900 and 700 feet offshore, respectively. Maximum onshore movements were: for the 6-foot depth contour, 1,500 feet, between South Amboy and Matawan Creek and 2,100 feet, near Point Comfort; for the 12-foot depth contour, 3,000 off Flat Creek; and for the 18-foot depth contour, 2,200 feet, between Compton Creek and the Shrewsburg River.

19. 1855-57 to 1886. During this period the 6, 12 and 18-foot contours moved both offshore and onshore. Maximum movements included 2,100 feet offshore for the 6-foot contour in the vicinity of Point Comfort, 1,200 feet offshore for the 12-foot contour off Cliffwood Beach and 4,500 feet onshore for the 18-foot contour off Atlantic Highlands.

20. 1886 to 1932-34. During this period the contours also moved offshore and onshore. Maximum movements included 1,400 feet onshore for the 6-foot contour in the vicinity of Conaskonk Point, 1,500 feet onshore for the 12-foot contour at Union Beach and 6,000 feet offshore for the 18-foot contour off Atlantic Highlands. The 1932-34 6-foot depth contour which extends into the mouth of Compton Creek indicates the location of the channel improvement undertaken by the U. S. Government.

21. 1932-34 to 1957. During the latest period of record, the general trend of the offshore depth contours was stable to onshore movement, with one exception in the Sayreville area where the 6-foot contour moved offshore about 1,000 feet, probably as a consequence of the artificial fill projects completed in 1953 and 1956 (see locations [a] and [b] on plate 5). Abrupt increases in depths between South Amboy and Laurence Harbor indicated by the 1957 profiles are a result of recent dredging for channel improvements. An onshore movement of 1,200 feet of the 6-foot depth contour at Keansburg occurred during the latest 23-year period.

III. PROFILES

22. 1957 profiles. Plates 8 to 10 show profiles taken by the Corps of Engineers between May and July 1957 along the coast of New Jersey from South Amboy to Highlands. These profiles were spaced one-half to one mile apart and generally extended at least one mile offshore. The locations of the profiles are shown on plates 2 to 4 by corresponding numbers. The typical foreshore slopes of the profiles vary from about 1 on 15 to about 1 on 40 and average about 1 on 30. However, there are six profiles where the foreshore slopes are considerably flatter than 1 on 40, generally reflecting the effects of recently placed artificial fill and nearby structures. Underwater slopes vary from 1 on 60 to 1 on 600 and average about 1 on 400.

23. Comparative profiles. Selected comparative profiles are shown on plate 11 including plotted data from U. S. Coast and Geodetic Survey maps of 1836, 1841, 1855-56, 1886, 1926, 1932-34 and the Corps of Engineers survey of 1957. Plotted points on comparative profiles prior to the 1957 survey

have not been joined by lines, since these data are limited and show little change offshore of the mean low water line. Generally, very little change has occurred in the configuration of the bay bottom during the entire period of record. The abrupt changes indicated on comparative profiles 3, 4 and 20 for the 1932-34 to 1957 period were caused by dredging as noted on plate 11. The changes shoreward of the mean low water line are described in paragraphs 3 to 15 under shore line changes.

IV. VOLUMETRIC ACCRETION AND EROSION

24. The existing groins and jetties in the study area have trapped only limited quantities of material, indicating that the amount of littoral drift along the shore is not appreciable. A study of hydrographic data and recent profiles between 1836 and 1957 (see plate 11) fails to disclose any significant accretion or erosion offshore of the mean low water line.

25. Substantial erosion is indicated, however, in the zone between mean low water and mean high water. Estimates of erosion along the frontage of the study area were made on the basis of available shore line data, in view of the lack of other survey information. The 1836-1886 period was selected for these estimates since natural shore conditions existed at that time without the modifying effects of groins and bulkheads. These conditions are considered comparable to the conditions which would prevail after the beach fill is placed under the proposed project.

26. Table D-1 shows estimated average annual volumetric changes from 1836 to 1886 divided into nine sections. Greatest losses occurred in the reach from Way Cake Creek to Pews Creek where the rate of erosion is estimated as 2 cubic yards per foot of shore per year. The reach extending from 1,000 feet east of Matawan Point to Matawan Creek shows an accretion of more than 2 cubic yards per foot per year. However, this value may be in error in view of the possible unreliability of the position of the high water shore lines in this flat marshy area, which were used as a basis for computation by the method described in the following paragraph.

27. Erosion and accretion computations have been based on a prism bounded by planes of mean low water and mean high water with a width corresponding to the average shore line change for each section. Since comparative data are not available shoreward of the mean high water line, it was assumed that this shoreward zone was subject to changes similar in magnitude to the tidal zone. Consequently, total average changes in table D-1 includes an allowance for changes above the plane of high water by doubling the figure obtained for the prism between the mean low water and mean high water planes. The estimated average annual volumetric erosion is considered indicative of the magnitude of replenishment requirements in the event that beach fill is placed in accordance with the proposed project.

Table D-1 - Estimated average annual volumetric changes, 1836-1886^(a)

Section	Length of shore (feet)	Average change between high and low water (c.y./yr.)	Estimated total average change ^(b) (c.y./yr.)	Estimated total change per foot of shore (c.y./ft./yr.)
South Amboy to Cheesequake Creek	10,900	- 6,200	-12,400	-1.1
Cheesequake Creek to Whale Creek	10,300	- 5,500	-11,000	-1.1
Whale Creek to 1,000 feet east of Matawan Point	5,400	- 3,700	- 7,400	-1.4
1,000 feet east of Matawan Point to Matawan Creek	3,100	+ 3,300	+ 6,600	+2.1
Matawan Creek to Flat Creek	18,500	-10,500	-21,000	-1.1
Flat Creek to Way Cake Creek	5,400	+ 400 ^(c)	+ 800	+0.1
Way Cake Creek to Pews Creek	15,400	-15,200	-30,400	-2.0
Pews Creek to Compton Creek	6,300	- 2,600	- 5,200	-0.8
Compton Creek to Shrewsbury River	36,100	- 1,600	- 3,200	-0.1

(a) + indicates accretion and - indicates erosion.

(b) Includes an allowance for changes above the high water line by doubling figure in previous column. Comparative profiles indicate that there has been little change below mean low water.

(c) The average annual change from 1836 to 1855-56 was -13,200 c.y./yr. and from 1855-56 to 1886 was +9,000 c.y./yr.

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APPENDIX E

EXISTING STRUCTURES AND PROTECTIVE MEASURES

1. General. This appendix presents a detailed description of existing structures along the shores of Raritan Bay and Sandy Hook Bay from the City of South Amboy to the Borough of Highlands, the effectiveness of these structures, and the current status of State and municipal protection projects. The location of the structures is shown on plates 2 to 4 of the main report. Fill placed in the study area since 1940 is indicated on plates 5 to 7. Photos 6 to 11 show typical protective works, some of which have been ineffective.

2. Three tables are included at the end of this appendix. Table E-1 gives the location, type of construction, dimensions, date of construction, present condition, and ownership of the major structures in the study area by localities. Structures which have been completely covered with sand are not listed in the table. This table also includes some data on a number of minor structures where the information was readily obtainable. Most piers in the area have been omitted from the table except for a few which may have some effect on the shore. Table E-2 gives details of hydraulic fill placed along the shore of the study area since 1940. Table E-3 gives a description of all work undertaken by the State of New Jersey for shore protection since 1929. The records of the Navigation Bureau of the State of New Jersey indicate that Federal financial aid was given to some communities through the Works Progress Administration for the construction of shore protection projects, however details of the nature of this work or the amount of Federal aid are not available. Descriptions of the measures taken for protection of the shore against erosion within each of the localities in the study area are given in the following paragraphs.

3. City of South Amboy. The principal structure along the South Amboy shore is a solid fill railroad pier, 335 feet wide and 1,000 feet long, normal to the shore. In 1940, the city constructed a 125-foot timber bulkhead east of this pier.

4. During the period from 1951-1953, the Federal Government placed a total of 6,135,000 cubic yards of hydraulic fill along the shore in the vicinity of the boundary between South Amboy and Sayreville. This material was obtained from dredging the Perth Amboy anchorage which is a part of the Federal navigation project for New York and New Jersey Channels. The fill runs approximately 3,200 feet along the shore and extends about 2,300 feet seaward of the shore line before fill. The material was placed to an elevation generally 15 feet or greater above mean low water. There has been no appreciable erosion in this area.

5. Borough of Sayreville. In addition to the fill placed by the Federal Government in this locality, which is discussed in the preceding paragraph, the Middlesex County Sewerage Authority placed 583,000 cubic yards of material in the area immediately to the east of the Federal fill in 1956. This material, which was dredged for the construction of the Authority sewer outfall, runs about 1,900 feet along the shore and extends about 1,300 feet seaward of the shore line before fill. This material is very silty and has flowed in an easterly direction along the bay bottom to some extent. From this fill area to the vicinity of the mouth of Cheesequake Creek, the shore is fronted by high bluffs. In this bluff area is located a stone seawall built by the Central Railroad of New Jersey prior to 1880 to protect its right-of-way. The condition of this wall varies from good to poor.

6. In 1958, the State and borough constructed 300 feet of bulkhead to protect the sewage disposal plant just west of the mouth of Cheesequake Creek. This bulkhead was extended an additional 399 feet in 1960.

7. At the mouth of Cheesequake Creek are two stone jetties built by the Federal Government as part of a project adopted by the River and Harbor Act approved 14 June 1880. The cost of this project, including dredging and other work, was \$40,000. As of 1883, the west jetty in Sayreville was 995 feet long and the east jetty in Madison Township was 925 feet in length. No further work was accomplished, and by June 1957 as a result of storm damage over a period of time, the west and east jetties had been reduced to 883 feet and 875 feet, respectively. There has been localized accretion at the inshore ends of both the west and east jetties.

8. Madison Township. With the exception of the east jetty at Cheesequake Creek, there are no records of any protective structures in Madison Township prior to 1935. In that year, 25 groins and about 2,500 feet of bulkhead were constructed. In general, these groins have not been successful in trapping material and there are only narrow beaches along the shore of the township and the condition of the groins varies from generally poor at the western end of the township to good at the eastern end. The bulkheads have been ineffective in holding the shore and are all in poor to fair condition except the one at the western end of the Laurence Harbor Cabin Colony which is in good condition. In 1952 and 1953 the State and township constructed a 1,263-foot long bulkhead along the frontage of Morgan Beach and Laurence Harbor to protect a number of homes at Morgan Beach which have been damaged in past storms and to arrest bluff erosion in Laurence Harbor which threatened to undermine a street. This bulkhead is presently in good condition, however, it is not tied into high ground at its ends.

9. Matawan Township. Prior to 1935, seven timber groins had been constructed in this locality. In 1935, 18 additional timber groins, each approximately 250 feet long, and about 6,000 feet of timber bulkhead were built. All of these structures were generally ineffective in building a beach or holding the shore. These structures have been heavily damaged in past storms and only nine groins and about 1,000 feet of bulkhead remain,

almost all being in poor condition. About mid-way between Whale Creek and Matawan Point, a stone seawall has been built to protect a swimming pool located near the shore. Just west of Matawan Point, there is a concrete seawall which was built to protect the high bluff at this point. The seawall has deteriorated, and the bluff is being severely eroded.

10. Borough of Keyport. The shore of this locality is protected by a number of structures, most of which are quite old, but still in fair to good condition. The only structures built within the last 30 years are two bulkheads. One of these, 376 feet in length, was built in 1951 to replace the damaged portion of an older bulkhead in the Marine Park off Front Street. The total length of bulkheading in the park is 670 feet. The second bulkhead, 341 feet long, was constructed in 1952 to protect the water plant. Although the shore line changes in this area, as shown on plate 5 of the main report, are relatively small, it is difficult to determine whether this is due to the numerous protective structures along the shore or to the relatively sheltered exposure of the shore.

11. Borough of Union Beach. The only protective structures in the borough are two timber bulkheads. One of these, 1,056 feet long, was constructed by the State and borough in 1954 to protect Front Street. The other bulkhead, which is 500 feet long, was constructed by private interests prior to 1930. Both structures are in good condition.

12. Borough of Keansburg. The shore of this municipality has been heavily protected with groins, bulkheading and the placement of artificial fill. The first known construction of protective works was accomplished in 1924-25, when private interests built five stone groins varying in length from 100 to 230 feet. The records of the New Jersey State Navigation Bureau indicate that these structures failed to collect enough material to build up the beach. During the period from 1931 to 1933, the State and borough constructed a number of timber and stone groins and about 1,300 feet of timber bulkhead. However, the shore continued to erode to a point where The Beachway, a street running parallel to the shore, was being threatened by wave attack.

13. About 1935, the borough constructed 25 timber groins, totaling 7,000 feet in length, 6,400 feet of timber bulkhead and removed a number of damaged groins. About 10,000 cubic yards of fill were placed shoreward of the bulkhead built in 1931. This area suffered further damage as a result of partial undermining of the bulkhead and formation of a pool of water behind the bulkhead. To correct this condition, approximately 3,000 cubic yards of additional fill was placed behind the bulkhead in 1938. Two years later, in 1940, the borough performed maintenance dredging in Way Cake Creek and deposited about 11,000 cubic yards of hydraulic fill along approximately 500 feet of shore immediately east of the mouth of the creek.

14. In 1954, the State and borough dredged about 81,000 cubic yards of material from offshore and placed it along approximately 1,100 feet of the Belvedere Beach section of the municipality. This fill had a berm elevation of 10 feet above mean low water for a width of 20 to 120 feet and

an average seaward slope of 1 on 20. In addition, a 400-foot long stone groin was constructed at the western end of the fill area to hold the material in place. The groin has effectively held the beach and there has been no appreciable erosion. An additional 31,000 cubic yards of material were placed along about 500 feet of shore at the end of Main Street using the same berm elevation and seaward slope used at Belvedere Beach. In 1957, an additional 438,000 cubic yards of fill were dredged from offshore and placed along approximately 6,000 feet of shore from Point Comfort east to the borough line. This material was placed to a maximum elevation of 13 feet above mean low water with a maximum berm width of about 80 feet and an average seaward slope of about 1 on 20. This material, which is a medium to fine sand, has been relatively stable with the exception of a small area near Point Comfort, where the high water line has receded approximately 50 feet within about a year after placement without the occurrence of a severe storm. This beach and the one at East Keansburg (see paragraph 15) have provided a measure of protection against tidal flooding and are used for recreation.

15. Middletown Township. In 1929, the State and township constructed three timber groins and 458 feet of timber bulkhead in East Keansburg. Three years later, in 1932, three additional timber groins varying in length from 185 to 217 feet and 1,497 feet of timber bulkhead were added. Two of the groins built in 1929 were extended for an additional 100 feet in 1942-43 and five additional 250-foot timber groins were constructed. At this time 198 feet of new timber bulkhead were added and 375 feet of the bulkhead built in 1932 were repaired. In 1952, an additional 335 feet of timber bulkhead were constructed and about 550 feet of existing bulkhead and groins were repaired.

16. Most of the groins described in the preceding paragraph were ineffective in trapping sufficient sand to build a beach. Finally in 1954, the State and township dredged 195,000 cubic yards of material from an offshore borrow area and placed it along about 2,100 feet of frontage at Ideal Beach to a maximum elevation of 13 feet above mean low water with a maximum berm width of about 80 feet and an average seaward slope of about 1 on 15. There has been no appreciable erosion of this fill.

17. Between the eastern limit of the fill and the mouth of Pews Creek are three stone groins in poor condition. Jetties have been constructed on both the east and west sides of the mouth of Pews Creek and there has been little evidence of accretion at either of these structures.

18. From the mouth of Pews Creek to Compton Creek, there are 13 timber groins, six of which were constructed by the State and township between 1942 and 1943. The balance of the groins and about 1,600 feet of timber bulkhead were constructed by private parties prior to 1930. Private interests have constructed about 2,100 feet of timber and steel sheet pile bulkhead just west of the mouth of Compton Creek to protect the fish processing plant at that location and to stabilize the west shore at the mouth of the creek.

19. In 1925, a stone jetty, about 350 feet in length, was constructed at the east side of Compton Creek by Middletown Township to protect the mouth of the creek. In 1943, the State and township realigned this jetty and extended it to a length of 574 feet. There has been no appreciable accretion at this structure. The Federal Government, in 1956, performed dredging in Compton Creek and deposited an estimated 100,000 cubic yards of fill along about 1,000 feet of shore to the east of the jetty.

20. The beaches along the shore of the Leonardo section of the township are generally good. At the western end of the area are two timber jetties at the mouth of the State boat basin. These were constructed by the township with Federal aid shortly before 1940. To the east of the jetties are four timber groins constructed by the State and municipality in 1942-43. From this point to the east boundary of the township there are an additional timber groin and about 600 feet of timber bulkhead. The structures in this area are generally in good condition. In addition to the above structures, the State, in 1945, performed maintenance dredging of the channel to the boat basin and placed about 54,000 cubic yards of fill in the area east of profile 24. There has been essentially no erosion of this material.

21. Borough of Atlantic Highlands. The principal structure in this locality is the 4,000-foot stone breakwater constructed by the Federal Government in 1939-40 as part of a navigation project adopted by the River and Harbor Act of 26 August 1937. This breakwater, which protects the borough boat basin, has required no maintenance and is currently in good condition. During construction, about 409,000 cubic yards of material were dredged from the anchorage area landward of the breakwater and placed on the adjacent shore. In 1956, the Federal Government performed maintenance dredging of this anchorage area and placed around 195,000 cubic yards of material along about 3,100 feet of shore east of the municipal piers.

22. Near the western boundary of the borough, there is a timber bulkhead built by private interests prior to 1930 which is presently in poor condition. East of this bulkhead, a small beach has been built up by four timber groins constructed before 1930. Along the eastern portion of the borough runs a stone seawall constructed by the municipality to protect the shore. This wall is in good condition.

23. In 1950, the Federal Government performed maintenance dredging of the Federal channel in the Shrewsbury River. The dredged material, which totaled about 134,000 cubic yards, was placed along 1,600 feet of shore at the boundary between the Boroughs of Atlantic Highlands and Highlands.

24. Borough of Highlands. The shore of this borough has been heavily protected with numerous structures, most of which have been generally effective in holding the shore line. The timber bulkheads in the area, which total close to 3,700 feet in length, have been constructed over a period of time commencing in about 1930 and continuing up to 1958. In

addition, there are eight groins in the area ranging from about 36 to 130 feet in length. Most of the structures in the borough are in good to fair condition. The most recent structure in the area is a timber bulkhead built at about the middle of this locality by the State and borough during 1957-58.

25. Current status of coast protection projects. At present, the State and Borough of Keansburg are in the preliminary stage of planning additional protective works within the borough. Details of this work have not been decided upon.

Table 2-1 - Protective structures

Type of structure	Location (Referenced to east coordinate on plates 2 to 4.)	Type of construction	Top elevation (feet above s.l.w.) Inner and Outer and		Top width (feet)	Length (feet)	Year built	Condition	Owner(s)
CITY OF SOUTH ARIZONA									
Pier	2,109,100	Timber, solid fill	10.6	10.8	335	1,000	(b)	Good	Private
Bulkhead	2,108,650 to 2,108,700	Timber	12.0		2.5	125	1940	Good	Municipality
BOROUGH OF BAYNEVILLE									
Seawall	2,111,600 to 2,112,600	Stone	(b)		(b)	1,850	Before 1880	Good to poor	Private
Bulkhead	2,111,000 to 2,111,150	Timber	12.0		3	699	1958-60	Good	State and Municipality
Jetty	2,113,500	Stone	3.6	4.6	6	833	1882-83	Good to poor	U.S. Gov't.
MADISON TOWNSHIP									
Jetty	2,113,700	Stone	4.8	4.7	6	875	1882-83	Good	U.S. Gov't.
Groin	2,113,750	Timber	6.6	2.5	1	255	1935	Poor	Municipality
Groin	2,113,950	Timber	8.2	1.7	1 to 2	63	1935	Poor	Municipality
Bulkhead	2,113,950 to 2,114,150	Timber	6.7 to 9.7		2	185	1935	Poor	Municipality
4 Groins	2,114,150 to 2,115,150	Timber	5.8 to 8.4	2.4 to 3.5	2 to 3	50 to 125	1935	Good to poor	Municipality
Bulkhead (c)	2,115,150 to 2,116,100	Timber	9.4 to 11.6		1.5 to 2	1,263	1952-53	Good	State and Municipality
4 Groins	2,115,650 to 2,116,500	Timber	3.5 to 8.7	1.9 to 4.1	1.5 to 2	120 to 215	1935	Fair to poor	Municipality
Groin	2,116,700	Timber	5.1	(b)	1.5 to 2	"	1935	Fair	Municipality
Bulkhead	2,116,700 to 2,117,250	Timber	9.1		2	765	1935	Fair	Municipality
Groin	2,117,250	Timber	9.6	3.6	2	110	1935	Good	Municipality
3 Groins	2,117,500 to 2,117,950	Timber	4.5 to 7.1	1.2 to 3.7	1.5 to 2	60 to 355	1935	Good to poor	Private
Bulkhead	2,117,950 to 2,118,700	Timber	9.0		1.5 to 2	675	1935	Good	Municipality
8 Groins	2,118,100 to 2,119,600	Timber	7.1 to 10.9	1.5 to 7.5	1	100 to 160	1935	Good to fair	Private
Bulkhead	2,119,800 to 2,120,350	Timber and concrete	12.7		1 to 2	840	1935	Poor	Private
Groin	2,119,800	Timber	10.9	3.6	2	145	1935	Fair	Private
Groin	2,120,050	Timber	10.6	3.4	1	140	1935	Fair	Private
MATAMORA TOWNSHIP									
Bulkhead	2,124,200 to 2,124,400	(b)	(b)		(b)	200	(b)	(b)	Private
Groin	2,124,400	Timber	9.6	1.7	1 to 2	250	1935	Good	Private
Groin	2,125,000	Timber	9.4	1.8	1	125	1935	Poor	Private
Seawall	2,124,900 to 2,125,200	Stone	7.8		4 to 5	315	1935	Good	Private
2 Groins	2,125,100 to 2,125,300	Timber	3.4 to 6.5	Submerged	1	100 to 130	1935	Poor	Private
Bulkhead	2,125,300 to 2,126,650	Timber	14.3		2	1,000	(b)	Poor	Private
3 Groins	2,125,500 to 2,126,200	Timber	4.7 to 7.8	Submerged	1	100 to 180	1935	Fair to poor	Private
Seawall	2,126,200 to 2,127,050	Concrete	13.9		1	1,100	1935	Fair to poor	Private
BOROUGH OF KETCHIKAN									
Bulkhead	2,127,700 to 2,128,000	Timber	12.2		1.5	670	1951 and prior years	Good	State and Municipality
Bulkhead	2,128,000 to 2,128,200	(b)	(b)		(b)	230	(b)	(b)	Private
Bulkhead	2,129,350 to 2,129,550	Timber	11.0 to 13.6		0.3	105	Before 1921	Fair	Private
Groin	2,129,550	Timber	7.8 to 9.8	3.3 to 11.8	1 to 10	100	Before 1930	Fair	Private
Groin	2,129,650	Timber	8.1	2.6	1	100	Before 1930	Fair	Private
Bulkhead	2,129,700 to 2,129,950	Concrete	13.3		1	250	(b)	Good	Private
Bulkhead	2,129,950 to 2,130,150	Timber	7.6		0.25	90	Before 1930	Good	Private
Bulkhead	2,130,350 to 2,130,550	Concrete	11.3		1	200	Before 1930	Fair	Private
Bulkhead	2,131,050 to 2,131,250	Timber	13.7		2	341	1952	Good	State and Municipality
3 Groins	2,131,500 to 2,131,700	Timber	6.1 to 7.9	3.0 to 5.7	1 to 1.5	75 to 100	Before 1930	Good	Private
Bulkhead	2,131,500 to 2,131,600	Concrete	9.9		1.5	100	Before 1921	Good	Private
Bulkhead	2,131,600 to 2,131,700	Timber	10.4		2	100	Before 1921	Fair	Private
Bulkhead	2,131,700 to 2,131,750	Concrete	10.7		1	50	Before 1921	Fair	Municipality

Table B-1 - Protective structures (Cont'd)

Type of structure	Location (Referenced to east coordinates on plates 2 to 4)	Type of construction	Top elevation (feet above M.L.V.) Inner and Outer end	Top width (feet)	Length (feet)	Year built	Condition	Owner (a)
BOROUGH OF UNION BRANCH								
Bulkhead	2,137,150 to 2,137,900	Timber	10.3 to 11.6	1	1,056	1954	Good	State and Municipality
Submer barge	2,138,050	Timber	11.1 (b)	35	250	(b)	Poor	Private
Bulkhead	2,138,400 to 2,138,750	Timber	11.9 to 12.0	2	500	Before 1930	Good	Private
BOROUGH OF KRAKOWBURG								
Bulkhead and submer barge	2,144,400	Timber	(b)	(b)	500	1937-38	Good to fair	Municipality
Croin	2,145,200	Timber	(b)	(b)	250	1935	(b)	Municipality
Croin	2,145,650	Timber	11.4 (b)	1	150	1935	Fair	Municipality
Bulkhead	2,145,650 to 2,145,900	(b)	(b)	(b)	400	(b)	(b)	Private
Croin	2,145,900	Timber	10.5 (b)	1	100	(b)	Fair	Private
Bulkhead	2,146,000 to 2,146,750	Timber	9.4 to 9.9	1	120	1935	Fair	Municipality
Croin	2,146,050	Stone	5.4 8.4	15	400	1954	Good	State and Municipality
Bulkhead	2,146,050 to 2,146,750	(b)	(b)	(b)	1,350	1935	(b)	Municipality
3 Croins	2,146,300 to 2,146,700	Timber	(b)	(b)	40 to 170	1935	(b)	Municipality
Pier	2,146,750	Timber	12.2 13.4	30	2,300	(b)	Good	Private
Bulkhead	2,146,800 to 2,147,700	Timber	(b)	(b)	900	1935	(b)	Municipality
Bulkhead	2,147,700 to 2,149,700	Timber	12.0	1	2,400	1935	Fair	Municipality
Croin	2,147,100	Stone	8.2 Submerged	8	150	1931	Good	Municipality
Croin	2,147,600	Stone	8.5 6.0	10	230	1964	Good	Private
Croin	2,147,750	Timber	(b)	(b)	00	1935	(b)	Municipality
2 Croins	2,148,050 to 2,148,250	Timber	(b)	(b)	00	1935	(b)	Municipality
Croin	2,148,350	Timber	(b)	(b)	00	(b)	(b)	Municipality
Croin	2,148,400	Stone	(b)	(b)	230	1964	(b)	Private
4 Croins	2,148,450 to 2,148,800	Timber	(b)	(b)	50 to 85	1935	(b)	Municipality
Croin	2,148,900	Stone	7.5 7.5	10 to 15	230	1964	Good	Private
3 Croins	2,149,100 to 2,149,300	Timber	(b)	(b)	50 to 75	1935	(b)	Private
3 Croins	2,149,400 to 2,149,800	Timber	(b)	(b)	150	1935	(b)	Municipality
Croin	2,150,550	Timber	(b)	(b)	250	1931	(b)	State and Municipality
Bulkhead	2,150,650 to 2,151,650	Timber	8.9	1 to 2	1,330	1931 & 1952	Good	State and Municipality
4 Croins	2,150,800 to 2,151,500	Timber	7.2 to 8.1 Submerged	1 to 2	200	1931	Good	State and Municipality
Croin	2,151,700	Stone	10.5 10.4	8 to 15	150	1925	Good	Private
Seawall	2,151,700 to 2,151,900	Stone	(b)	(b)	200	(b)	(b)	Private
Croin	2,151,900	Stone	12.8 12.6	10	100	1925	Good	Private
HIGHLAND TOWNSHIP								
11 Croins	2,153,050 to 2,155,550	Timber	2.7 to 8.2 2.3 to 4.4	1	92 to 265	1929, 1932 & 1942-43	Good to poor	State and Municipality
3 Croins	2,155,700 to 2,155,900	Stone	3.2 to 4.6 Submerged	10	60 to 90	(b)	Poor	(b)
Bulkhead	2,155,750 to 2,156,100	(b)	(b)	(b)	350	(b)	(b)	(b)
Jetty and bulkhead	2,156,500	Timber	3.1 to 5.1 6.9 to 7.7	2	450	1929 & 1942-43	Good	Municipality
Jetty	2,156,600	Timber	4.4 6.9	2	196	1942-43	Good	Municipality
Bulkhead	2,156,600	Timber	6.0 3.0	2	240	Before 1930	Good	Private
2 Croins	2,157,450 to 2,158,750	Timber	4.6 to 9.5 1.7 to 4.5	0.2 to 1	200	Before 1930	Fair to poor	Private
Bulkhead	2,158,750 to 2,160,250	Timber	11.9	2	1,580	Before 1930	Poor	Private

Table H-1 - Protective structures (Cont'd)

Type of structure	Location (Referenced to east coordinate on plates 2 to 4)	Type of construction	Top elevation (feet above m.l.w.) Inner and Outer end		Top width (feet)	Length (feet)	Year built	Condition	Owner
MIDDLETON TOWNSHIP (Cont'd)									
3 Groins	2,122,000 to 2,160,250	Timber	6.0 to 10.7	4.4 to 6.1	1	160 to 185	Before 1930	Fair	Private
5 Groins	2,160,450 to 2,160,950	Timber	9.0 to 11.0	0.9 to 5.7	1	70 to 190	1942-43	Fair to poor	State of Maryland
Bulkhead	2,161,650 to 2,162,250	Timber	10.4 to 10.6		1	650	Before 1930	Good	Private
Groin	2,162,250	Timber	6.7	(b)	1	250	1942-43	Good	State
Bulkhead	2,162,250 to 2,163,200	Steel, sheet pile	9.9 to 11.0		1	1,469	Portions built prior to 1951, 1952 & 1957	Good	Private
Jetty	2,162,050	Stone	9.5	13.1	6	574	1925 & 1943	Good	State of Maryland
Pier	2,166,650	Timber & concrete	(b)	(b)	50 to 100	11,300	1943-45	Good	U. S. Coast Guard
Jetty	2,164,550	Timber	4.0	5.3	1	260	Before 1940	Good	State
Jetty	2,164,700	Timber	6.8	5.2	1	50	Before 1940	Good	State
4 Groins	2,169,100 to 2,169,900	Timber	4.1 to 5.2	3.6 to 5.0	1	55 to 145	1942-43	Good	State of Maryland
Groin	2,171,200	Timber	6.4	4.5	1	110	(b)	Good	Private
Bulkhead	2,171,400 to 2,171,800	Timber	11.0 to 14.9		1	400	(b)	Good	Private
Bulkhead	2,172,050 to 2,172,100	Timber	(b)	(b)	(b)	225	(b)	(b)	(b)
BOROUGH OF ATLANTIC BEACHES									
Bulkhead	2,172,600 to 2,173,300	Timber	9.3 to 9.8		1	775	Before 1930	Poor	Private
4 Groins	2,173,700 to 2,174,150	Timber	5.7 to 7.9	2.6 to 4.1	2	70 to 150	Before 1930	Fair	Private
Breakwater	2,176,050 to 2,180,000	Stone	10.4	7.8	12 to 15	4,000	1939-40	Good	U. S. Coast Guard
Bulkhead	2,175,550 to 2,176,650	Timber	9.7 to 11.3		11	1,150	1916	Good	Municipal
Seawall	2,180,250 to 2,183,800	Stone	8.7 to 11.6		6	3,830	1916	Good	Municipal
BOROUGH OF HIGHLANDS									
Bulkhead	2,185,600	Timber	10.2	10.4	9	75	Before 1940	Good	Private
Bulkhead	2,186,400 to 2,186,600	Timber	10.2 to 10.4		9	225	(b)	Good	(b)
Groin	2,186,600	Timber	10.4	10.3	2	40	Before 1940	Good	Private
Bulkhead	2,187,450 to 2,188,550	Timber	10.6		2.5	1,354	1934, 1957 & 1958	Good	State of Maryland
2 Groins	2,188,650 to 2,188,700	Timber	8.8 to 10.0	6.6 to 6.9	1	36 to 75	About 1945	Good	Private
2 Groins	2,188,000 to 2,188,900	Timber	7.1 to 9.2	5.3 to 7.3	1.3	50 to 65	About 1945	Fair	Private
2 Groins	2,189,090 to 2,189,100	Timber	9.3 to 9.7	4.4 to 9.3	1 to 1.5	35 to 110	1936	Fair	Municipal
Groin	2,189,900	Timber	9.5	9.1	5	130	Before 1940	Fair	Private
Bulkhead	2,189,900 to 2,190,150	Timber	8.0 to 10.4		1	300	Before 1940	(b)	(b)
Bulkhead	2,190,200 to 2,190,250	Timber	8.2		1	415	(b)	Fair	(b)
Bulkhead	2,190,250 to 2,190,300	Timber	9.6		5	688	(b)	Good	(b)
Bulkhead	2,191,400 to 2,190,300	Timber	9.6 to 9.9		1	105	1954-57	Fair	Municipal
Bulkhead	2,190,700	Timber	6.7 to 7.4		1	147	Before 1940	Fair	Municipal
Bulkhead	2,190,800 to 2,190,900	Timber	8.8		1 to 2	360	About 1930	Good	Private
Bulkhead	2,190,900	Timber	7.3		1	75	About 1930	Good	Private

(a) Data listed is based on best available sources and in some cases have not been legally established.

(b) Data not available.

(c) Another timber bulkhead in fair condition is located about 50 feet shoreward at the base of a bluff.

Table E-2 - Fill placed since 1940^(a)

Designation on plates 5 to 7	Location	Quantity of fill (cu. yds.)	Length along shore (feet)	Year completed	Work by
[a]	South Amboy-Sayreville	6,135,000	3,200	1953	U. S. Government
[b]	Sayreville	583,000	1,900	1956	Middlesex County Sewage Authority
[c]	Keansburg	11,000	500	1940	Municipality
[d]	Keansburg	81,000	1,100	1954	State and municipality
[e]	Keansburg	438,000	6,000	1957	State and municipality
[f]	Keansburg	31,000	500	1954	State and municipality
[g]	Middletown Township	195,000	2,100	1954	State and municipality
[h]	Middletown Township	100,000	1,000	1956	U. S. Government
[i]	Middletown Township	54,000	1,000	1945	State
[j]	Atlantic Highlands	409,000	2,000	1941	U. S. Government
[k]	Atlantic Highlands	195,000	3,100	1956	U. S. Government
[l]	Highlands	134,000	1,600	1950	U. S. Government

(a) Fill which was placed landward of bulkheads is excluded.

Table E-3 - Projects undertaken by State
of New Jersey since 1929

Location	Year completed	Type of work	Cost in dollars ^(a)
Sayreville	1958-60	Timber bulkhead at sewage treatment plant.	66,300
Madison Township	1952	Timber bulkhead.	74,600
	1953	Timber bulkhead.	56,600
Keyport	1951	Timber bulkhead.	24,100
	1952	Timber bulkhead.	24,100
Union Beach	1954	Timber bulkhead.	54,000
Keansburg	1931	Timber groins and bulkhead.	15,500
	1952	Timber bulkhead.	15,000
	1954	Stone groin and 112,000 cubic yards of hydraulic fill ^(b) .	66,600
	1957	438,000 cubic yards of hydraulic fill.	194,400
Middletown Township	1929	Timber groins and bulkhead in East Keansburg.	9,500
	1932	Timber groins and bulkhead in East Keansburg.	15,200
	1942-43	Timber groins and bulkheads in East Keansburg, Port Monmouth, and Leonardo.	73,000
	1943	Stone jetty at Compton Creek.	36,100
	1945	54,000 cubic yards of hydraulic fill at Leonardo.	21,600
	1952	Timber bulkhead in East Keansburg.	23,000
	1954	195,000 cubic yards of hydraulic fill in East Keansburg.	78,800
Highlands	1955	Timber bulkhead.	78,600
	1957-58	Timber bulkhead.	14,700
Total			941,700

(a) Approximately one-half of the cost was borne by the State of New Jersey and the remainder by local governments.

(b) 81,000 cubic yards of this fill were placed at location d on plate 6 and 31,000 were placed at location f.

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APPENDIX G

POLLUTION DATA

1. General. This appendix presents a brief history on the water pollution problem in prior years, the progress made in the improvement of conditions through sewage treatment plant installations and results of recent observations to determine water quality in the bay area. Restrictions pertaining to discharge of sewage into the waters along the study area based on a Tri-State Compact are also presented.

2. Restrictions against discharge of sewage. Restrictions against discharge of sewage are contained in the Tri-State Compact for Pollution Abatement adopted by the States of New Jersey, New York and Connecticut. Article VII of the Compact contains the following provisions which are applicable to the waters of Raritan and Sandy Hook Bays. These waters have been classified as Class A which designates areas expected to be used primarily for recreational purposes, shellfish culture or the development of fish life.

"1. It is agreed between the signatory States that no sewage or other polluting matters shall be discharged or permitted to flow into, or be placed in, or permitted to fall or move into the tidal waters of the district, except under the following conditions and restrictions:

"(1) All sewage discharged or permitted to flow into Class "A" waters of the district shall first have been so treated as-

"(a) to remove all floating solids and at least sixty per centum (60%) of the suspended solids; and

"(b) to effect a reduction of organisms of the B. Coli group (intestinal bacilli) so that the probable number of such organisms shall not exceed one per cubic centimeter in more than fifty per centum (50%) of the samples of sewage effluent tested by the partially confirmed test; provided, however, that in the case of discharge into waters used primarily for bathing this bacterial standard need not be required except during the bathing season; and

"(c) to effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the district and in the general vicinity of the point of discharge of the sewage into those waters, at a depth of about five feet below the surface, of not less than fifty per centum (50%) saturation during any week of the year."

3. The Interstate Sanitation Commission which was created by the Compact has the authority to determine if the above provisions are complied with and to bring action in the courts to compel the enforcement of the Compact.

4. History of water pollution problem. The history of the water pollution problem in Raritan and Sandy Hook Bays is based on information contained in a report submitted to the Chief of Engineers by the Second New York District on 29 April 1925 pursuant to Section 9 of the Oil Pollution Act approved 7 June 1924. This report discloses that bay waters were polluted by large quantities of untreated domestic sewage and industrial wastes and that very few adequate treatment facilities were in existence at that time. Estimates in the report indicate that many millions of gallons per day of raw wastes were discharged from Perth Amboy, South Amboy, Keansburg, Atlantic Highlands and Highlands. It also indicated that large quantities of untreated wastes were carried into Raritan Bay from the Raritan River.

5. Pollution abatement measures. There has been considerable progress in pollution abatement in the Raritan and Sandy Hook Bays area since submission of the report mentioned in the preceding paragraph. Table G-1 which has been compiled largely from data published by the Interstate Sanitation Commission lists the sewage treatment facilities which have been provided in the study area and the immediate vicinity since 1928 at an estimated cost of \$34,490,000. In addition to these facilities, local interests propose to construct a treatment plant for a new housing development at Knollcroft in Madison Township and are preparing preliminary plans for the modernization and enlargement of the existing plants at Keyport and Keansburg. There are no communities in the study area where raw sewage is known to be discharged.

6. Information obtained from the Interstate Sanitation Commission on 10 June 1960, discloses that inspections made in 1959 indicates that the existing sewage treatment plants have complied with the requirements of the Commission most of the time with the exception of the Keyport and Keansburg plants which have met the requirements about 50 percent of the time. As noted in the preceding paragraph, action is being taken to improve the conditions at these plants.

7. Results of recent water quality observations. Results of three years of observations to determine the water quality of Raritan Bay and other waterways in the vicinity are contained in a report entitled "Raritan River-Raritan Bay Survey" issued in March 1960 by the Chief Chemist of the Middlesex County Sewerage Authority and the Principal - Public Health Engineer of the New Jersey State Department of Health. This report presents data on water conditions in 1957 before operation of the Middlesex County Sewerage Authority treatment facilities and in 1958, 1959 and early 1960 after commencement of operations. One of the indices used in the survey to determine water quality conditions is the coliform organism density. A density of 2,400 coliform organisms per 100 milliliters is ordinarily regarded as the maximum acceptable for bathing purposes.

Table G-1 - Existing sewage treatment facilities

Location	Date built	Estimated cost (dollars)	Flow (M G D)		Estimated population served
			average	design	
City of Perth Amboy	1934	424,000	5.4	10.0	42,000
City of South Amboy	1940	135,000	0.6	1.0	8,400
Borough of Sayreville (Middlesex County Sewerage Authority)	1958	32,655,000	36.0	52.0	299,400
Borough of Sayreville, Melrose Section	1949	200,000	0.04	0.1	1,000
Borough of Sayreville, Morgan Section	1951	300,000	0.1	0.3	2,000
Borough of Keyport	1936(a)	50,000	0.8	0.4	5,900
Borough of Keansburg	1949(a)	494,000	1.5	2.0	5,600
U. S. Navy Depot at Leonardo	1943	(b)	0.01	0.8	(b)
Borough of Atlantic Highlands	1928	80,000	0.37	0.6	3,000
Borough of Highlands	1928	152,000	0.38	1.2	3,000
Total		34,490,000	45.20	66.4	370,300

(a) Year of major additions or reconstruction.

(b) Not available.

8. Analyses of a number of water samples taken at the mouths of the Raritan River and Arthur Kill show that only 30 percent of the samples examined during 1957 would have been considered acceptable for bathing, while in 1958, 62 percent of the samples would have been acceptable. In 1959, approximately 59 percent of the samples examined would have been acceptable.

9. Analyses of samples obtained in 1957 from Raritan Bay within an approximate 1,700-yard radius of the Middlesex County Sewerage Authority outfall discharge point show that only 40 percent of the samples examined would have been considered suitable for bathing purposes. In 1958, 78 percent of the samples passed bathing water standards and in 1959 some 76 percent passed similar standards in the same area.

10. It is to be noted that both of the areas mentioned in paragraphs 8 and 9 have shown a significant improvement in coliform density between 1957 and 1958 and that the quality of the waters in these areas remained substantially at the same level in 1959.

11. Two other areas further to the east were also examined during the survey. Analyses of samples taken from one of these areas which extended across Raritan Bay from Laurence Harbor, N. J. to Seguin Point, Staten Island showed that 95 percent of the 1957 samples would have been acceptable for bathing, while in 1958 and 1959, 99 and 94 percent, respectively, would also have been suitable. This indicates that conditions with respect to coliform densities have remained essentially the same over the three year survey period. Samples taken from an adjacent area to the southeast extending approximately to Conaskonk Point revealed relatively low coliform densities in both 1957 and 1958. This area was eliminated in 1959 for additional investigation in view of the findings obtained in 1958.

12. It is to be noted that the data given in paragraphs 8 to 11 do not include analyses of samples which showed increased coliform densities following heavy rainfalls and subsequent surface water runoff. The authors of the aforementioned report indicate that the effect is not included in the data as an effort was made to present base-line conditions. They also indicate that the sanitary significance of the presence of the coliform organisms is somewhat questionable under such conditions.

13. Recent data on water quality conditions in the more easterly portions of Raritan Bay and in Sandy Hook Bay are not available. However, it is possible that the water conditions there are equivalent to or better than those indicated for the areas mentioned in the preceding paragraphs because of the closer proximity to the Atlantic Ocean.

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APPENDIX K

ESTIMATES OF LOSSES AND BENEFITS

I. FLOOD DAMAGES

1. General. This section presents information on the conduct of tidal flooding damage surveys undertaken in connection with the subject study, classification of damage data obtained during the course of the surveys, losses experienced during three recent major storms, and estimates of recurring damages. Supporting data developed to determine annual benefits from prevention of tidal flooding and from beach erosion control due to the considered improvement are given in section II of this appendix.

2. Damage surveys. In connection with the hurricane study authorized by Public Law 71, 84th Congress, approved 15 June 1955, a storm damage survey was recently completed of the New Jersey shore areas along Raritan and Sandy Hook Bays, from South Amboy to Highlands. This survey was primarily a physical inventory of the area subject to tidal flooding. Since there are numerous residences of similar character in the area, a sampling method was used. Estimated evaluations of damages were based on a combination of data furnished by property owners, estimates by field investigators, and unit stage-damage relationships developed for similar areas. Recurring damage data were obtained for various stages of storm waters up to an elevation 3 feet above the stages which occurred during the extratropical storm of 25 November 1950, which was the maximum of record storm prior to the hurricane of 12 September 1960 (Donna).

3. Loss classification. Damage data were recorded by classification and location of loss. The loss classifications used were residential, commercial, public, utility, and highway. The classification of loss was also compiled by municipalities and subdivisions to facilitate later use in stage-damage and benefit estimates.

4. The losses evaluated are confined to tangible primary damages. Primary losses comprise (1) physical damages caused by inundation, and (2) non-physical losses, such as cost of evacuation and temporary quarters, unrecovered loss of business, and increased cost of operation.

5. The primary loss resulting from physical damages, and a part of the related non-physical loss, were determined by direct inspection of property and evaluation of losses by property owners and field investigators or both. Local officials were interviewed in order to obtain the nature and scope of emergency measures and costs. Data on loss of business were obtained from

owners of commercial property in the study area. The non-physical portion of the primary loss is sometimes difficult to estimate on the basis of information available at a given property. In areas where this condition exists, the non-physical losses were estimated by utilizing relationships between physical and non-physical losses as determined from damage studies of similar properties in the survey area and other areas. In establishing the stage-damage relationships, allowances, based on damages which have occurred during recent storms, were made for the effects of improvements by local interests in Madison Township, Keansburg and East Keansburg.

6. Secondary tangible losses, consisting of flood-related losses, such as loss of production and wages in areas outside the immediate flood areas, have not been determined. Intangible losses, including loss of life, health, security, and detrimental effects upon national defense have not been monetarily evaluated.

7. Experienced damages. The extensive damages experienced during the hurricane of 14 September 1944, the extratropical storm of 25 November 1950, and the hurricane of 12 September 1960, which produced the maximum tide of record in the study area, are indicative of the severity of losses in this area. Details on the effects of these storms are given in the following paragraphs. Additional data on the effects of other storms are contained in appendix C.

8. Hurricane of 14 September 1944. This hurricane caused losses estimated at over \$2,500,000 (1944 prices) in the study area. At Keyport, a railroad spur, and all boat docks and piers were destroyed. The sewage and water plants were flooded and a concrete bulkhead at the water plant was destroyed. Three steamboats, including the "Smithfield" (see photo 12) were driven ashore.

9. In Union Beach, bay waters reached 500 to 1,000 feet inshore. Artificial dunes were damaged and almost the entire beach was washed away. Homes and stores were flooded and a section of streets and walks was washed out by wave action.

10. During this storm, flood waters reached points 1,500 to 2,000 feet inshore in Keansburg. Waves destroyed the steamboat pier and the entire boardwalk with its amusement buildings and business properties. The water-front street was washed out, damaging sewer and water lines, jetties, and bulkheads. Nearly all frame buildings collapsed when struck by heavy debris. Twelve summer cottages were demolished. Many other homes were flooded and furnishings were damaged in this locality.

11. Tidal stages which exceeded bulkhead heights resulted in washed-out roads, walks, and pavements in Middletown Township. Boardwalks in Ideal Beach and Port Monmouth were destroyed by waves. Homes and hotels were flooded and several homes were destroyed by wave impact.

12. Flooding in Atlantic Highlands extended shoreward about 500 feet, except at one point, where bay water penetrated 2,000 feet inshore over a width of 500 feet. Several piers were damaged by waves and the railroad tracks near the shore were washed out. In addition, water flooded homes, hotels, stores, and the sewage treatment plant.

13. At Highlands, the storm caused damage to streets, sewers, water lines, and bulkheads. About 150 homes, 20 hotels, numerous stores, and the sewage and water plants were inundated. Several pavilions were destroyed by waves.

14. Extratropical storm of 25 November 1950. This storm, which produced the second highest tide of record, caused over \$2,000,000 of primary physical and non-physical damage in the study area. According to newspaper accounts, there was one death in Union Beach and another in Keansburg.

15. A section of the Central Railroad of New Jersey in South Amboy was washed out, causing disruption of rail service in the area. In addition, several streets and homes were inundated.

16. In the Morgan Beach and Laurence Harbor area, over 250 families had to be evacuated by rowboat. Approximately 50 homes were destroyed, about 30 more were badly damaged, and scores of others suffered minor damage to structures and furnishings (see photos 14 and 15). Residential damages were estimated at \$500,000. At Laurence Harbor, a new boardwalk was wrecked, beach concessions were destroyed, and a new casino was heavily damaged.

17. Damages to boats and boat facilities in the Cliffwood Beach-Keyport area were estimated at \$150,000. A former Navy cargo carrier, the Brig. Gen. Horton, was beached near Matawan Creek and a second cargo carrier went aground in the Cliffwood Beach area. The steamboat, the City of New York, was high aground at the foot of Broadway in Keyport and at least 50 smaller craft were washed into back yards and on the main road. High tides in Matawan Creek inundated several roadways between Matawan and Cliffwood. Portions of State Highway Number 35 were also flooded and traffic was interrupted.

18. At Union Beach, one house was completely demolished and many others were damaged. About 55 families were evacuated. A 1,200-foot section of roadway and curbing on Front Street, two bridges, the water plant, and numerous bulkheads were damaged.

19. At Keansburg, where floodwaters extended almost a mile inland, the borough was placed under martial law. Residents were evacuated from their homes with the aid of troops and equipment from Fort Monmouth. A section of the eastern end of the boardwalk for a distance of about 150 feet was washed away, and most of the beach concessions and amusement stands were destroyed or severely damaged. A number of homes and business establishments near the beach front were inundated and damaged.

20. About 200 people were evacuated in East Keansburg. At Leonardo, Atlantic Highlands, and Highlands, boats and piers were damaged severely by tide and wave action in Sandy Hook Bay. The yacht basin in Atlantic Highlands was wrecked. The entire downtown section of Highlands was flooded, resulting in the evacuation of the residents and heavy damage to many commercial establishments. Beach erosion was extensive, and many streets in the area were damaged.

21. Hurricane of 12 September 1960 (Donna). The maximum of record tides produced by this hurricane caused primary physical and non-physical damage estimated at about \$6,000,000. Had the storm occurred about a week earlier, before summer vacationists returned to their permanent homes, its impact would have been much greater, particularly with respect to the number of persons requiring evacuation. Plates 2 through 4 of the main report show the extent of the flooded areas. A description of the damage caused by the storm is given in the following paragraphs.

22. In Madison Township, a number of bungalows in the Morgan Beach area had more than 4 feet of water over their first floors and several were moved from their foundation. A 30-foot sailboat was carried over a bay-front bulkhead and wedged between two homes (see photo 18). State Highway Number 35 was impassable east of Cheesequake Creek and a tavern between the highway and the bay was severely damaged. To the east of this area, a road on top of a bluff was washed out by waves undermining the base of the bluff and about 70 cabins in the Laurence Harbor Cabin Colony were destroyed or very severely damaged (see photo 19).

23. In Matawan Township, about 40 cabins were destroyed or badly damaged, the seaward end of a waterfront tavern was demolished, and a boardwalk in front of a swimming pool was washed away. In Keyport, several waterfront stores were flooded to depths up to 5 feet and numerous piers and boats were damaged.

24. The Borough of Union Beach was flooded by waters from Raritan Bay and Chingarora, Flat, and East Creeks. Most of the stores along the shore suffered heavy damage. Two houses east of Flat Creek were totally destroyed and two others partially destroyed. About 100 people were evacuated when their homes were flooded. The embankment of the Central Railroad of New Jersey was washed out at several locations, resulting in a disruption of service in the study area. In Raritan Township, water flooded the streets from the bay to about three blocks south of the railroad. Many homes and automobiles suffered inundation damage.

25. Keansburg, where flood waters came inland a mile from the shore, was the hardest hit community in the study area (see photos 20 to 23). Local officials estimated the damage to be in the excess of \$2,000,000 with damage to municipal property over \$250,000. This is in substantial agreement with an independent estimate of about \$2,700,000 made by the New York District. Water came over the beach and up Way Cake Creek as far as the

railroad. In the Point Comfort amusement area, outside the limits of the recently placed beach fill, most of the concessions were destroyed or severely damaged by wave attack and tidal inundation. Along the rest of the shorefront, where fill had been placed, the beaches were overtopped by high tides resulting in the inundation of thousands of homes and business establishments. However, these beaches were successful in breaking the storm waves and there was little damage caused by wave attack in this area. During the storm, five buildings were destroyed by fire when fire-fighting equipment could not reach them because of flooded streets. About 800 persons were evacuated from their homes. State police aid was required to prevent looting in the borough.

26. The western portion of Middletown Township experienced severe damage. The beaches in East Keansburg were overtopped and many homes were damaged. Near Pews Creek, two homes were totally destroyed and the bridge over the creek was washed out. Over 400 persons were evacuated from homes in East Keansburg and Port Monmouth. In Port Monmouth and Belford, where a number of homes were severely damaged, prevention of looting became a major police problem. In Leonardo, the jetties at the State marina were damaged and the homes along the shore suffered minor damage due to flooding.

27. At Atlantic Highlands and Highlands, boats and piers were severely damaged by the storm. In Highlands, water was 4 to 5 feet deep on the main street and a great number of stores and homes were flooded. Newspapers carried reports of raw sewage floating in the borough streets. A bulkhead recently constructed by the State was flanked by the tide and the street behind the bulkhead was washed out.

28. Recurring damages (1960 prices). It is anticipated that conditions in the study area will be restored substantially to those existing prior to the hurricane of 12 September 1960 (Donna) including replacement of structures and facilities destroyed during the storm. On this basis it is estimated from the stage-damage curves (figure K-3), which were developed immediately prior to hurricane Donna, that the recurrence of the maximum tidal heights which accompanied this storm would cause \$7,300,000 of primary physical and non-physical damage, of which about two-thirds would be residential. It is to be noted that the stage-damage curves include the effects of possible occurrence of some storms during the summer vacation period when the activity in the study area is greatest. The lesser damage which resulted from the September 1960 storm given in paragraph 21 is due to the fact that it occurred after the summer season. The primary physical and non-physical damages which would result from occurrence of the design storm surge at time of predicted mean tide are estimated at \$12,000,000. The damages which would result from occurrence of this storm surge at time of high tide would be almost doubled.

II. ANNUAL BENEFITS FROM CONSIDERED IMPROVEMENT

29. General. Benefits which are evaluated in the following paragraphs are based on (1) prevention of primary damages from tidal flooding, (2) land to be saved from erosion, (3) recreational benefits from additional

beach use, (4) decrease in maintenance costs of existing beach structures, and (5) prevention of erosion damage. Item (1) was considered as entirely applicable to the hurricane protection phase of the considered improvement, since any segregation of this benefit between shore and hurricane protection would have a negligible effect on the project economics and would necessarily be based on tenuous assumptions. Items (2) through (5) apply only to the beach erosion control phase of the improvement. It should be noted that table K-3 and subsequent tables include estimates of beach erosion control benefits for an improvement at Leonardo, which was later found to be uneconomic. Totals in these tables are therefore given with and without the improvement at Leonardo. No estimated benefits are given for improvements in the other areas which have been found to have a very low economic justification on the basis of a preliminary evaluation. The evaluated benefits are based on present (November 1960) price levels. Land enhancement benefits have not been evaluated since there would be little new or higher use of the land in the study area as a result of the construction of the proposed protective works. Most, if not all, of the enhancement of land values in the study area would be due to prevention of physical damage and improvement in conditions of beach use, benefits from which have already been evaluated. Any additional enhancement benefits would be negligible. The hurricane protection would also result in a reduction of loss of life. Benefits from elimination of scare costs in connection with hurricanes have not been evaluated, since they would have a minor effect on the project economics. Details on the computation of these benefits are discussed in the following paragraphs.

30. Prevention of primary flood damages. The hurricane protection phase of the considered improvement would result in a total reduction of flood damages during the design hurricane of \$6,560,000 consisting of \$5,930,000 in the Borough of Keansburg and East Keansburg; \$310,000 in Laurence Harbor; and \$320,000 in Morgan Beach. A description of the method used in arriving at an estimate of benefits from prevention of damages from tidal inundation is contained in the following paragraphs.

31. One of the most difficult tasks in arriving at an estimate of average annual benefits from prevention of tidal inundation is the development of an extreme high tide frequency relationship. This is due to the lack of tide data for past storms, the difficulty of predicting the frequency of occurrence of future hurricanes and other major storms and the uncertainty as to the future rise of sea level. Therefore, in preparing the composite tide frequency curve shown in figure K-1, use was made of all available information having a bearing on this matter. At the inception of the study, it was found that the storm tides for a particular storm were noticeably different at the eastern and western ends of the study area. It was further noted that the higher tide did not always occur at the same end of the bay. This was due to a number of reasons, including the type of storm and its path. In addition, it was found that extreme high tides resulted from two causes, hurricanes and other tropical storms and extra-tropical storms.

32. Available tide data for Sandy Hook, and Perth Amboy, New Jersey at the eastern end and western end of the study area, respectively, for the period 1939 to 1958 were utilized to develop the lower part of the curve in figure K-1. From these tide data, four curves were drawn, giving the frequency of high tides at Perth Amboy and Sandy Hook, separately for tropical and extratropical storms. The plotting positions for the maximum of record tides caused by the hurricane of 12 September 1960 (Donna) were computed on the basis of a 67-year period, since the tide caused by this storm at Fort Hamilton, which has the longest tide record in the vicinity of the study area, was the highest recorded since the gage was placed in operation in 1893. It has been determined that there is good correlation between the tides in Raritan and Sandy Hook Bays and the tide at Fort Hamilton. The aforementioned curves were averaged to obtain two stage-frequency curves, one for tropical storms and the other for extratropical storms, which are considered to be representative for the entire study area.

33. To obtain the upper part of the tropical storm curve, use was made of the hurricane central pressure frequency relationship for latitude 41°N developed by the U. S. Weather Bureau and contained in its "Report on Hurricane Frequency Studies" dated 12 February 1957 and memorandum HUR 2-1 dated 18 June 1957 (see figure C-2 of appendix C) and the estimated hurricane surges contained in "The Prediction of Hurricane Storm-Tides in New York Bay" by Basil W. Wilson, published by the Agricultural and Mechanical College of Texas in October 1959. The results obtained from the Weather Bureau data were divided by three in arriving at the upper part of the tropical storm frequency curve. This was considered reasonable in view of the fact that the study area is affected by storms passing through only about a 65-mile wide portion of the 200-mile wide band used by the Weather Bureau for the hurricane central pressure frequency relationship (see figures C-1 and C-2 of appendix C) and therefore the frequency for the study area may be expected to be only one-third of the frequency for the entire band. The upper part of the extratropical storm frequency curve was obtained by extrapolation of the computed data. The final frequency curve shown on figure K-1 was obtained by adding together the frequencies for tides caused by both tropical and extratropical storms. This figure also shows frequency curves for high tides separately for tropical and extratropical storms. It is to be noted that elevations on the figure refer to mean sea level, which is the average condition for astronomical tide.

34. A comparison of the frequency relationship presented in the preceding paragraph with the storm frequency developed from historical records indicates that the relationship is reasonable. A check was made of the frequency of a storm tide of 9 feet which is equivalent to that produced by an unusually severe storm. The frequency of such a storm is 3.6 percent (see table C-4 of appendix C) which compares reasonably well with the frequency of 5.0 percent for a tide of 9 feet as given in figure K-1.

35. Figure K-2 shows the annual mean range of tide and annual mean tide levels at Fort Hamilton in the general vicinity of the study area from 1893 to 1959. The former indicates the changes in the mean range of tide in accordance with the normal 19-year cycle. Although the average rate of

rise of mean tide level (sea level) during this 67-year period was about 1 foot per century, the rise during the last 30 years has been at the rate of 2 feet per century. If this rate were to continue, mean sea level at the end of the assumed 50-year life of the considered improvement would be 1 foot higher than at present. However, in view of the uncertainty as to the future rise of sea level and the lack of other firm data on extreme high tide frequency, the effect of the possible continued rise of sea level was not included in the tide frequency curve shown in figure K-1.

36. Figures K-3¹ and K-3² show the stage-damage curves for damages due to tidal inundation for the individual communities in the study area. Stage-damage relations for these communities, broken down between primary physical and primary non-physical damages, are given in table K-1. The stages referred to above do not include wave run-up, but the effect of run-up is included in the damages. No evaluation of physical damage to vehicles either underway or parked has been made.

37. The correlation of the above-mentioned tide frequency data and stage-damage data resulted in a damage-frequency relation, which was converted to equivalent annual damages by mathematical integration. By use of this method, the average annual losses in the study area under existing conditions up to the level of a standard project hurricane, was estimated as \$1,073,700 as given in table K-2.

38. The average annual benefit from reduction of tidal inundation damages as a result of the considered improvement was taken as the average annual damage from flooding eliminated up to an elevation of 10.4 feet above mean sea level, which is the design surge elevation. Benefits were not claimed for the occurrence of the design surge coincident with a stage of tide above mean sea level, since there is an equal chance of this surge occurring when the predicted tide will be below mean sea level. This annual benefit totaling \$360,500, consists of \$11,100 at Morgan Beach, \$23,700 at the Laurence Harbor Cabin Colony and \$325,700 in Keansburg and East Keansburg.

39. Land to be saved from erosion. Under the considered plan of improvement, sufficient direct fill and nourishment would be provided along the shores of Madison and Matawan Townships, Borough of Union Beach and Leonardo to eliminate loss of land due to erosion. The annual value of land to be saved from erosion which is estimated at \$8,300, excluding Leonardo, as given in table K-3, is based on the average annual rate of recession of the shore during the period 1836 to 1886 with the effect of present shore structures considered and present (May 1960) land values. The shore line changes during this period are shown on plates 5 to 7 of the main report. The benefit to the public shores has been taken as a public benefit, and the benefit to private shores was taken as a private benefit.

40. Recreational benefits from additional beach use. Since the beaches in the study area are inadequate for present recreational use the accomplishment of the considered beach erosion improvements would result

Table K-1 - Primary physical and non-physical damages from inundation
(in dollars)

Location	Stage in feet above mean sea level(a)																	
	6			7			8			9			10			11		
	Physical	Non-physical	Total	Physical	Non-physical	Total	Physical	Non-physical	Total	Physical	Non-physical	Total	Physical	Non-physical	Total	Physical	Non-physical	Total
City of South Amboy	6,000	0	6,000	38,000	6,700	44,700	97,000	11,000	108,000	181,000	13,900	194,900	272,000	15,800	287,800	364,000	17,500	381,500
Borough of Sayreville(b)	4,000	600	4,600	14,300	1,300	15,600	28,000	1,800	29,800	43,800	2,100	45,900	58,500	2,300	60,800	73,600	2,500	76,100
Madison Township																		
Morgan Beach	3,300	500	3,800	17,000	1,900	18,900	27,300	3,600	30,900	57,000	6,300	63,300	302,700	9,000	311,700	309,000	11,100	320,100
Laurence Harbor Cabin Colony	0	0	0	14,100	16,900	31,000	98,700	16,900	115,600	289,100	16,900	306,000	289,100	16,900	306,000	289,100	16,900	306,000
Matawan Township(c)	5,500	200	5,700	28,400	11,500	39,900	90,600	17,100	107,700	243,800	19,000	262,800	318,800	19,900	338,700	358,600	19,900	378,500
Borough of Keyport	0	0	0	9,000	4,000	13,000	47,500	10,000	57,500	91,000	14,000	105,000	122,000	17,000	139,000	139,500	20,000	159,500
Borough of Union Beach	44,400	6,800	51,200	119,500	14,500	134,000	321,400	40,500	361,900	591,700	64,200	655,900	1,060,400	112,800	1,173,200	1,590,300	157,400	1,747,700
Raritan Township	12,600	1,900	14,500	34,800	5,000	39,800	90,900	12,600	103,500	177,600	21,900	199,500	286,600	32,900	319,500	467,700	50,400	518,100
Borough of Keansburg	14,000	1,000	15,000	230,000	20,000	250,000	1,513,600	112,000	1,625,600	2,635,400	188,200	2,823,600	3,892,500	254,700	4,147,200	5,124,900	328,100	5,453,000
Middletown Township																		
East Keansburg	7,200	300	8,000	53,000	5,000	58,000	242,300	19,400	261,700	538,800	41,300	580,100	904,500	60,300	964,800	1,339,200	87,000	1,426,200
Port Monmouth	0	0	0	22,000	16,000	38,000	72,000	58,000	130,000	155,000	126,000	281,000	255,000	169,000	424,000	353,000	194,000	547,000
Belford	0	0	0	1,000	800	1,800	5,500	1,000	6,500	13,200	1,100	14,300	24,100	1,200	25,300	36,000	1,700	37,700
Leonardo(d)	0	0	0	123,000	20,000	143,000	290,000	30,000	320,000	368,000	35,000	403,000	422,000	39,000	461,000	470,000	41,000	511,000
Atlantic Highlands	0	0	0	25,000	0	25,000	65,000	0	65,000	104,000	0	104,000	143,000	0	143,000	180,000	0	180,000
Highlands	65,000	45,000	110,000	295,000	100,000	395,000	775,000	160,000	935,000	1,095,000	207,000	1,302,000	1,350,000	235,000	1,585,000	1,575,000	260,000	1,835,000
Total	162,000	56,800	218,800	1,024,100	223,600	1,247,700	3,764,800	493,900	4,258,700	6,584,400	756,900	7,341,300	9,701,200	985,800	10,687,000	12,669,900	1,207,500	13,877,400

(a) Does not include wave run-up, but the effect of run-up is included in the damage.

(b) Includes only that portion of the borough of Sayreville which borders Raritan Bay.

(c) Includes the portion of Madison Township adjoining Whale Creek.

(d) Includes damage to the United States Navy Depot.

K-8

12517

Table K-2 - Estimated average annual losses
from tidal inundation (dollars)

Section	Annual losses
City of South Amboy	23,900
Borough of Sayreville ^(a)	9,300
Madison Township	
Morgan Beach	15,300
Laurence Harbor Cabin Colony	27,700
Matawan Township ^(b)	31,400
Borough of Keyport	12,200
Borough of Union Beach	123,800
Raritan Township	36,800
Borough of Keansburg	354,500
Middletown Township	
East Keansburg	79,000
Port Monmouth	35,000
Belford	2,000
Leonardo	63,000
Atlantic Highlands	15,100
Highlands	<u>238,700</u>
Total	1,073,700

(a) Includes only that portion of the Borough of Sayreville which borders Raritan Bay.

(b) Includes the portion of Madison Township adjoining Whale Creek.

Table K-3 - Estimated annual benefit from land to be saved
from erosion as a result of shore protection

Section	Acres per year	Value per acre (dollars)	Annual benefit (dollars)	Distribution of annual benefit (dollars)		
				Public bene- fit to pub- lic shore	Private benefit	
					Private shore with public benefit	Private shore with no pub- lic benefit
<u>Madison Township</u>						
Morgan Beach	0.01	7,000	100	0	0	100
Thence to Laurence Harbor Cabin Colony	0.10	7,000	700	700	0	0
Laurence Harbor Cabin Colony	0.06	7,000	400	0	400	0
Seidler's Beach	0.12	7,000	800	0	800	0
Knollcroft	0.06	7,000	400	0	400	0
Thence to Whale Creek	0.07	7,000	500	0	500	0
Subtotal	0.42	--	2,900	700	2,100	100
<u>Matawan Township</u>						
Cliffwood Beach Cabin Colony	0.27	8,000	2,200	0	2,200	0
Thence to Matawan Point	0.15	8,000	1,200	0	1,200	0
Subtotal	0.42	--	3,400	0	3,400	0
<u>Borough of Union Beach</u>	0.22	9,000	2,000	800	200	1,000
<u>Middletown Township</u>						
Leonardo	0.21	9,000	1,900	500	400	1,000
Total	1.27	--	10,200	2,000	6,100	2,100
Total (excluding Leonardo)	1.06	--	8,300	1,500	5,700	1,100

in recreational benefits to the public from additional beach use. Due to the complex nature of the New York Metropolitan region, in which the study area is located, it was found that the usual methods of estimating additional beach use as a result of improved beaches were not entirely applicable to this study. To estimate the beach use after the completion of the proposed improvement, the daily peak load for each beach in the study area was computed by using the capacity of the beach after improvement based on 75 square feet per bather, which studies have shown to be the maximum desirable beach density, adjusted to allow for the accessibility of the beach to centers of population, available recreational facilities, and relative popularity of the beach in attracting bathers, as well as the effects of nearby competing beaches. The beach densities as a result of this adjustment varied from 750 square feet per bather in some areas of Madison and Matawan Townships to 150 square feet per bather at many of the more accessible and attractive beaches in the area. The seasonal attendance was then computed using a 90-day season with the average daily attendance equal to one-third of the maximum.

41. The results of the above computations give a peak daily load of 30,000 bathers for the entire study area and a seasonal load of 900,000 including the attendance at the recently improved beaches in Keansburg and East Keansburg. It was found that the application of the above method of computation to the beaches at Keansburg and East Keansburg yielded a result which agreed closely with previous estimates of seasonal attendance at these beaches. It should be noted that the population of Middlesex and Monmouth Counties plus Essex, Hudson and Union Counties, all of which are about one-hour travel time from the study area by auto, is over 2,800,000.

42. The present annual use of the beaches in the study area is estimated at 540,000 visits. The anticipated increase is therefore 360,000 including Leonardo (348,800 excluding Leonardo). Considering the economic conditions and the beach ownership in the study area and the degree of the anticipated public benefit per bather, the net recreational value per person for beach use is evaluated at \$0.35, which is considered to be equivalent to the charges that would probably be made if the beaches were privately owned and operated. Based on the foregoing, the recreational benefits from the proposed improvement, excluding Leonardo, total \$121,900 as given in table K-4.

43. Decrease in maintenance costs of existing beach structures. The restoration of protective and recreational beaches at the various localities would result in a decrease in maintenance cost of a number of existing bulkheads and groins. Based on data obtained on the maintenance costs of shore structures, it is estimated that the annual maintenance costs of these structures would be reduced by \$0.50 per linear foot. The reduction in maintenance of publicly-owned and privately-owned structures were considered public and private benefits, respectively. The benefits resulting from this decreased maintenance cost, which total \$3,200, excluding Leonardo, are given in table K-5.

Table K-4 - Estimated annual public recreational benefit
from additional beach use as a result of
shore protection (dollars)

Section	Annual benefit	Distribution of benefit	
		Public shore	Private shore
<u>Madison Township</u>			
Morgan Beach	9,000	9,000	0
Thence to Laurence Harbor Cabin Colony	27,700	20,000	7,700
Laurence Harbor Cabin Colony	4,200	0	4,200
Seidler's Beach	23,600	0	23,600
Knollcroft	2,300	0	2,300
Thence to Whale Creek	2,700	0	2,700
Subtotal	69,500	29,000	40,500
<u>Matawan Township</u>			
Cliffwood Beach Cabin Colony	39,300	0	39,300
Thence to Matawan Point	4,300	0	4,300
Subtotal	43,600	0	43,600
<u>Borough of Union Beach</u>	8,800	7,000	1,800
<u>Middletown Township</u>			
Leonardo	4,300	4,300	0
Total	126,200	40,300	85,900
Total (excluding Leonardo)	121,900	36,000	85,900

Table K-5 - Annual benefit from decrease in maintenance costs of existing structures

Section	Length of structures (feet)				Annual benefit (dollars)(a)				Total
	Public shore	Private shore with public benefit		Private shore, no public benefit	Public shore	Private shore with public benefit		Private shore, no public benefit	
		Public structure	Private structure			Public benefit	Private benefit		
<u>Madison Township</u>									
Morgan Beach	964	0	0	0	500	0	0	0	500
Thence to Laurence Harbor Cabin Colony	709	855	0	0	400	400	0	0	800
Laurence Harbor Cabin Colony	0	675	860	0	0	300	400	0	700
Seidler's Beach	0	0	440	0	0	0	200	0	200
Knollcroft	0	0	0	0	0	0	0	0	0
Thence to Whale Creek	0	0	0	0	0	0	0	0	0
Subtotal	1,673	1,530	1,300	0	900	700	600	0	2,200
<u>Matawan Township</u>									
Cliffwood Beach Cabin Colony	0	0	350	0	0	0	200	0	200
Thence to Matawan Point	0	0	0	0	0	0	0	0	0
Subtotal	0	0	350	0	0	0	200	0	200
<u>Borough of Union Beach</u>	1,056	0	0	500	500	0	0	300	800
<u>Middletown Township</u>									
Leonardo	0	370	0	510	0	200	0	300	500
Total	2,729	1,900	1,650	1,010	1,400	900	800	600	3,700
Total (excluding Leonardo)	2,729	1,530	1,650	500	1,400	700	800	300	3,200

(a) Computed on basis of 50 cents per foot of structure.

44. Prevention of erosion damage. Several areas in Madison and Matawan Townships have experienced severe bluff erosion caused by waves attacking the base of the bluffs and undermining them. This erosion, if allowed to continue, will cause the destruction of a number of buildings and several streets together with the appurtenant utilities. The proposed protective beaches would break the waves before they reached the bluff and thus prevent these losses. The annual benefit was computed by amortizing the replacement cost of the threatened structures over the fifty-year life of the project. The benefit to private buildings along private shores was taken as a private benefit. The total benefits, amounting to \$3,700, are given in table K-6. Since, as is noted in paragraph 24 of appendix H, the recommended fill section for bluff areas is the most economic method of providing the minimum degree of shore protection, these benefits result directly from meeting the minimum beach erosion control needs.

45. Summary. Table K-7 gives a breakdown of the \$137,100 benefit from shore protection, which excludes Leonardo, including a separation of the benefit between public and private interests. A final summary of all benefits totaling \$497,600, excluding Leonardo, is given in table K-8.

**Table K-6 - Estimated annual benefit from prevention
of erosion damages (dollars)**

Section	Estimated total damage	Annual benefit
<u>Madison Township</u>		
Morgan Beach	0	0
Thence to Laurence Harbor Cabin Colony	15,000	500 ^(a)
Laurence Harbor Cabin Colony	0	0
Seidler's Beach	0	0
Knollcroft	45,000	1,600 ^(b)
Thence to Whale Creek	0	0
Subtotal	60,000	2,100
<u>Matawan Township</u>		
Cliffwood Beach Cabin Colony	0	0
Thence to Matawan Point	45,000	1,600 ^(b)
Subtotal	45,000	1,600
<u>Borough of Union Beach</u>	0	0
<u>Middletown Township</u>		
Leonardo	0	0
Total	105,000	3,700

(a) Public benefit to public shore.

(b) Private benefit to private shore open to public use.

Table K-7 - Breakdown of estimated annual benefits from shore protection (dollars)

Section and item	Benefit from land to be saved from erosion		Recreational benefits (a)	Decreased maintenance costs of structures		Prevention of erosion damages		All benefits		
	Public	Private	Public	Public	Private	Public	Private	Public	Private	Total
Morgan Beach										
Public shore	0	0	9,000	500	0	0	0	9,500	0	9,500
Private shore with public benefit	0	0	0	0	0	0	0	0	0	0
Private shore with no public benefit	0	100	0	0	0	0	0	0	100	100
Total	0	100	9,000	500	0	0	0	9,500	100	9,600
Total public and private benefits	100		9,000	500		0		9,600		
Thence to Laurence Harbor Cabin Colony										
Public shore	700	0	20,000	400	0	500	0	21,600	0	21,600
Private shore with public benefit	0	0	7,700	400	0	0	0	8,100	0	8,100
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	700	0	27,700	800	0	500	0	29,700	0	29,700
Total public and private benefits	700		27,700	800		500		29,700		
Laurence Harbor Cabin Colony										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	400	4,200	300	400	0	0	4,500	800	5,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	400	4,200	300	400	0	0	4,500	800	5,300
Total public and private benefits	400		4,200	700		0		5,300		
Seidler's Beach										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	800	23,600	0	200	0	0	23,600	1,000	24,600
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	800	23,600	0	200	0	0	23,600	1,000	24,600
Total public and private benefits	800		23,600	200		0		24,600		
Knollcroft										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	400	2,300	0	0	0	1,600	2,300	2,000	4,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	400	2,300	0	0	0	1,600	2,300	2,000	4,300
Total public and private benefits	400		2,300	0		1,600		4,300		
Thence to Whale Creek										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	500	2,700	0	0	0	0	2,700	500	3,200
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	500	2,700	0	0	0	0	2,700	500	3,200
Total public and private benefits	500		2,700	0		0		3,200		
Cliffwood Beach Cabin Colony										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	2,200	39,300	0	200	0	0	39,300	2,400	41,700
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	2,200	39,300	0	200	0	0	39,300	2,400	41,700
Total public and private benefits	2,200		39,300	200		0		41,700		
Thence to Matavan Point										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	1,200	4,300	0	0	0	1,600	4,300	2,800	7,100
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	1,200	4,300	0	0	0	1,600	4,300	2,800	7,100
Total public and private benefits	1,200		4,300	0		1,600		7,100		
Borough of Union Beach										
Public shore	800	0	7,000	500	0	0	0	8,300	0	8,300
Private shore with public benefit	0	200	1,800	0	0	0	0	1,800	200	2,000
Private shore with no public benefit	0	1,000	0	0	300	0	0	0	1,300	1,300
Total	800	1,200	8,800	500	300	0	0	10,100	1,500	11,600
Total public and private benefits	2,000		8,800	800		0		11,600		
Leonardo										
Public shore	500	0	4,300	0	0	0	0	4,800	0	4,800
Private shore with public benefit	0	400	0	200	0	0	0	200	400	600
Private shore with no public benefit	0	1,000	0	0	300	0	0	0	1,300	1,300
Total	500	1,400	4,300	200	300	0	0	5,000	1,700	6,700
Total public and private benefits	1,900		4,300	500		0		6,700		
Grand total public and private benefits	10,200		126,200	3,700		3,700		143,800		
Grand total (excluding Leonardo)	6,300		121,900	3,200		3,700		137,100		

(a) All recreational benefits are public.

Table K-8 - Summary of estimated annual benefits from
shore and hurricane protection (dollars)

Section	Shore protection benefits	Hurricane protection benefits	Total benefits
<u>Madison Township</u>			
Morgan Beach	9,600	11,100	20,700
Thence to Laurence Harbor Cabin Colony	29,700	0	29,700
Laurence Harbor Cabin Colony	5,300	23,700	29,000
Seidler's Beach	24,600	0	24,600
Knollcroft	4,300	0	4,300
Thence to Whale Creek	3,200	0	3,200
Subtotal	76,700	34,800	111,500
<u>Matawan Township</u>			
Cliffwood Beach Cabin Colony	41,700	0	41,700
Thence to Matawan Point	7,100	0	7,100
Subtotal	48,800	0	48,800
<u>Borough of Union Beach</u>	11,600	0	11,600
<u>Borough of Keansburg and East Keansburg</u>	0	325,700	325,700
<u>Leonardo</u>	6,700	0	6,700
Total	143,800	360,500	504,300
Total (excluding Leonardo)	137,100	360,500	497,600

CONNECTICUT
MAINE
MASSACHUSETTS
NEW HAMPSHIRE
NEW JERSEY
NEW YORK
RHODE ISLAND
VERMONT

U. S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
REGION ONE

P. O. Box 1749
Trenton, New Jersey

July 7, 1960

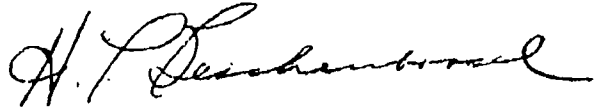
C. M. Duke
Colonel, Corps of Engineers
District Engineer
U.S. Army Engineer District, New York
111 East 16th Street
New York 3, New York

Dear Colonel Duke:

Please refer to your letter, Reference WJNGS, dated June 17, 1960, relative to a report dealing with beach erosion control and hurricane protection of the area along Raritan and Sandy Hook Bays between South Amboy and Highlands, New Jersey.

New Jersey Highways 35 and 36 are a part of our Federal-aid system on which construction and maintenance are performed by the New Jersey State Highway Department with or without Federal-aid. Any changes in construction on the Federal-aid system and in which the Bureau of Public Roads has participated, will be subject to our approval after the State's approval.

Very truly yours,



E. P. Deschenbassel
Division Engineer

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE

PUBLIC HEALTH SERVICE

REGION 11
42 BROADWAY
NEW YORK 4, N. Y.

Refer to: 24: SE

August 3, 1960

District Engineer
Corps of Engineers
U.S. Army Engineer District,
New York
111 East 16th Street
New York 3, N. Y.

Dear Sir:

Reference is made to your letter of June 17, 1960 requesting our comments concerning proposed beach erosion control and hurricane protection along Raritan and Sandy Hook Bays.

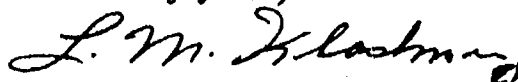
We have reviewed this project with the New Jersey Health Department and they can see no reason why this proposal should have any adverse affect on their water supply or pollution control program.

The plan as outlined provides for beach fill, groins, levees and interior drainage facilities. This plan should be beneficial from the mosquito control standpoint, since hurricane flood waters are noted for producing huge broods of salt-marsh mosquitoes, particularly *Aedes sollicitans*.

Production of fresh-water mosquitoes above the proposed works, will be minimized by the provision of the necessary interior drainage facilities.

For the Regional Engineer.

Sincerely yours,



Lester M. Klashman
Regional Program Director,
Water Supply & Pollution Control



ADDRESS ONLY THE
REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
59 TEMPLE PLACE
BOSTON, MASSACHUSETTS

NORTHEAST REGION
(REGION 5)

MAINE
NEW HAMPSHIRE
NEW YORK
VERMONT
PENNSYLVANIA
MASSACHUSETTS
NEW JERSEY
RHODE ISLAND
DELAWARE
CONNECTICUT
WEST VIRGINIA

October 10, 1960

District Engineer
New York District
U. S. Corps of Engineers
111 East 16th Street
New York 3, New York

Dear Sir:

Your letter of June 17, 1960 requested our comments regarding proposed beach erosion control and hurricane protection for the area along Raritan and Sandy Hook Bays between South Amboy and Highlands, New Jersey. The plan of improvement provides for beach fill, groins, levees, and interior drainage facilities. The major construction will consist of: (1) 14,150 feet of beach fill and 13,290 feet of levee in the Keansburg area east from Way Cake Creek to Pews Creek; (2) 3,000 feet of beach fill at Union Beach west of Flat Creek; and (3) 13,600 feet of beach fill and 1,940 feet of levee in Madison and Matawan Townships from Cheesequake Creek east to Matawan Point.

The proposed plan would have little or no effect on waterfowl and other game populations but will adversely affect the shellfishery and may affect finfish in the area.

We are mainly concerned with the borrow areas for beach fill. Fill will be taken by hydraulic dredge from the bay at a minimum of 1,500 feet offshore totalling over 3-1/2 million cubic yards of material. These proposed borrow areas contain a valuable shellfishery consisting of hard and soft clams and have a potential for oyster production. A portion of this resource would be destroyed by the dredging operation.

That portion of Raritan Bay east from Conaskonk Point to Port Monmouth, 1000 feet and over offshore, is extremely valuable since it contains the only unpolluted waters in Raritan Bay open to the commercial shellfishery. The remaining dredging sites contain shellfish populations which serve as a reservoir for this unpolluted area and stock for transplanting to clean waters. The value of the shellfishery in this area, largely hard clams, is estimated at nearly \$1,000,000 annually.

Sport fishing is an important form of recreation in the area. Also there is a limited amount of commercial fishing, mostly pound netting. The 2 most important species present are fluke and porgy. This project could enhance or it could adversely affect this resource. Improperly circulating water in the borrow areas could produce detrimental pockets of hydrogen sulfide. Fish habits and habitat could be radically changed affecting commercial netting. There is the possibility that the addition of deeper water areas in some portions of the bay could produce better sport by concentrating the fish.

Any disturbance or removal of the fine sands and silts will destroy hard clam habitat. Also, if silt removed by the dredging process is permitted to accumulate on adjacent habitat further clams will be destroyed. Fortunately, the materials preferred as beach fill are the coarser sands. However, borings show that good fill is many times overlain by shallow clam-producing silt deposits. In these cases less clam habitat will be lost if fill is taken from deeper borrow pits, but the danger of poor water circulation and the formation of hydrogen sulfide increase with the depth of borrow areas. Continuous trenches connected with deeper water would permit better circulation than would isolated borrow pits, and sloping sides would be preferred to steep sides. A trench up to 40 feet deep, having a minimum width of 150 feet and with sloping sides, would give the desired water circulation. A shallower trench could, of course, be narrower and give the same results. Therefore we recommend --

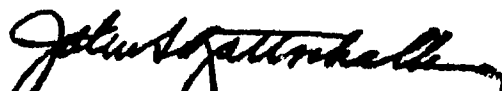
(1) That whenever possible hydraulic fill be taken from continuous trenches with sloping sides and not isolated pits. Trenches should connect with deeper water whenever possible.

(2) That these trenches be as deep as possible to minimize the loss to the shellfishery. A trench up to 40 feet deep having a minimum width of 150 feet and sloping sides should give the desired effects.

(3) That silt from borrow pits be removed either to shore or to deeper waters to minimize siltation of adjacent shellfish.

The foregoing report has the concurrence of the New Jersey Department of Conservation and Economic Development, Divisions of Fish and Game, and Shell Fisheries. The Division of Shell Fisheries plans to submit a further report of their findings shortly. This letter may be considered our report on the project and no further fish and wildlife studies by this Bureau will be required.

Sincerely yours,



John S. Gottschalk
Regional Director



State of New Jersey
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
SALVATORE A. BONTEMPO, Commissioner

DIVISION OF PLANNING AND
DEVELOPMENT
KENNETH H. CREVELING
DIRECTOR

August 25, 1960 PLEASE ADDRESS REPLY TO:

Bureau of Navigation
137 E. State Street

Colonel C. M. Duke, District Engineer
U. S. Army Corps of Engineers
New York District Engineer
111 East 16th Street
New York 3, New York

RE: Federal Beach Erosion Control
and Hurricane Protection Study-
Raritan and Sandy Hook Bays
Between South Amboy and Highlands

Dear Colonel Duke:

Reference is made to your letter of June 17, 1960 transmitting for review and comment copies of description of the considered plan of improvement for beach erosion control and hurricane protection of the area along Raritan and Sandy Hook Bays between South Amboy and Highlands, N. J.

You asked that we include in our reply any comments from the affected municipalities and counties as well as other State agencies including specifically the State Highway Department and the State Department of Health.

To facilitate response from all local interests we furnished copies of the description as issued by your office to the ten (10) municipalities within the study area; to the two (2) counties involved; and to the State Departments of Highway and Health. We also arranged for a joint conference to be held July 21, 1960 at Freehold, N. J.

In addition, at the request of the Middlesex County Board of Freeholders a further conference was held with the Middlesex County interests at New Brunswick on August 5, 1960. At that meeting a stenographic transcript of the proceedings at Freehold

July 21st was furnished to your representatives. The minutes of the meeting in New Brunswick on August 5th prepared by your office have been reviewed and they cover that second meeting.

At this date we have not received a comment from either the State Highway Department or the State Department of Health.

On the basis of the two conferences and the notices issued we feel that it is proper to consider that due notice has been given to all local interests. In general the two hearings did not produce any serious objections or criticisms. It is considered a fair statement that the proposed plans of improvements were acceptable to the local interests.

The Department's view is that the proposed work has been well conceived and outlined in the description. We have only one comment in that connection. We wish to draw attention to the fact that the three (3) groins proposed in the Borough of Keansburg at Port Comfort are being discussed with the municipality. Funds are available for construction. The issue at this time is whether stone groins or timber groins should be used. We will advise you further on this situation.

We have reviewed the local cooperation requirements and find that they are standard in projects of this nature. To meet the several conditions particularly installation of parking and bathing facilities will require cooperation between all levels of government. For this reason it should be understood that we cannot indicate at this time that the State would undertake to meet all of the local requirements. On the question of holding harmless the United States it is most probable that the State could meet this obligation only upon due authorization by Legislature. In the case of the Delaware River 40 foot project there was specific legislation authorizing such action.

Very truly yours,

BUREAU OF NAVIGATION



BY: Peter J. Gannon
Chief

PJG/rj



State of New Jersey
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
SALVATORE A. BONTEMPO, COMMISSIONER

DIVISION OF PLANNING AND
DEVELOPMENT

KENNETH H. CREVELING
DIRECTOR

November 29, 1960

PLEASE ADDRESS REPLY TO:
Navigation Bureau
137 E. State St.
Trenton 25, N.J.

Colonel C. M. Duke, District Engineer
U. S. Army Corps of Engineers
New York District Engineer
111 East 16th Street
New York 3, New York

RE: Federal Beach Erosion Control and Hurricane
Protection Study - Raritan and Sandy Hook
Bays Between South Amboy and Highlands

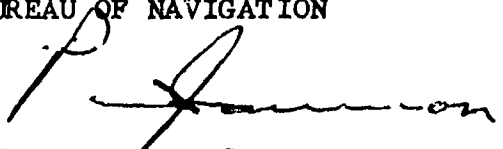
Dear Colonel Duke:

This letter is supplemental to our letter of
August 25, 1960, in which we advised that no comment had
been received from the New Jersey Departments of Highway
and Health on the proposed plan of improvement under the
above study.

We transmit herewith for your information and
retention letter dated September 15, 1960 from the Depart-
ment of Health and letter dated November 23, 1960 from the
State Highway Department.

Very truly yours,

BUREAU OF NAVIGATION


BY: Peter J. Gannon
Chief

PJG:RS
attachment

ROSCOE P. KANDLER, M.D., M.P.H.
STATE COMMISSIONER OF HEALTH



ALFRED H. FLETCHER, B.S., M.S., DIRECTOR
DIVISION OF ENVIRONMENTAL HEALTH

State of New Jersey
DEPARTMENT OF HEALTH
TRENTON 25

September 15, 1960

Refer to 6E5G6

Commissioner Salvatore A. Bontempo
Dept. Conservation & Economic Development
520 East State Street
Trenton, New Jersey

Dear Commissioner Bontempo: Re: U. S. Corps of Engineers Proposed
Beach Erosion Control, Raritan Bay
and Sandy Hook Bay

In consideration of the letter dated June 17, 1960 from Colonel C. M. Duke addressed to you, we wish to advise that the above project has been reviewed by both our Stream Pollution Control and Shellfish Sanitation Programs. There appears to be no reason to believe that the contemplated projects would have any adverse effect upon either of these Programs in New Jersey.

I trust that the information furnished by this office to the Corps of Engineers in connection with their studies has been useful to them.

If you desire any additional comments, please advise accordingly.

Very truly yours,

Alfred H. Fletcher
Alfred H. Fletcher, Director
Division of Environmental Health

6E5:G6



IN REPLY PLEASE REFER TO

State of New Jersey
STATE HIGHWAY DEPARTMENT
DWIGHT R. G. PALMER, COMMISSIONER
TRENTON 25

November 23, 1960

Mr. James K. Rankin
Chief Engineer
Navigation Bureau
Department of Conservation
and Economic Development
137 East State Street
Trenton 25, New Jersey

Dear Mr. Rankin:

This is relative to your letter concerning Project 462-
Federal Coast Protection and Hurricane Study Raritan
Bay and Sandy Hook Shorefronts.

Inasmuch as damage caused by these storms adds up to a
large expenditure, not only of public funds but also
private funds, any protection against this damage that
can be given should be considered.

We, therefore, have no objection to the general plan
proposed in the report submitted by the Army Engineers.

Very truly yours,

O. H. Fritzsche
O. H. Fritzsche
State Highway Engineer

INTERSTATE SANITATION COMMISSION

10 COLUMBUS CIRCLE

NEW YORK 19, N. Y.

TELEPHONE JUDSON 2-0300

COMMISSIONERS

NEW JERSEY

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DANIEL F. B. HICKEY
J. LOUIS RADEL
WILLIAM B. WISE

THOMAS R. GLENN, JR.
DIRECTOR-CHIEF ENGINEER

September 14, 1960

District Engineer
U. S. Army Corps of Engineers
111 East 16th Street
New York 3, New York

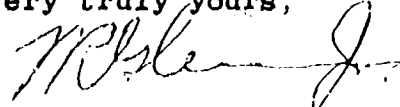
Reference: NANGS

Dear Sir:

We have reviewed the draft of portions of your report on beach erosion control and hurricane protection of the area along Raritan and Sandy Hook Bays between South Amboy and Highlands, New Jersey. We find this report a fair appraisal of the area in question and the material correct, which was obtained from this Commission.

We regret the delay in the response to your request for review and comment.

Very truly yours,



Thomas R. Glenn, Jr.
Director & Chief Engineer

TRG:k



THE CENTRAL RAILROAD COMPANY OF NEW JERSEY

• JERSEY CENTRAL TERMINAL • JERSEY CITY 2, N. J. • Telephone DElaware 2-112

B. J. MINETTI, Chief Engineer

September 16, 1960

Colonel C. M. Duke, District Engineer
U. S. Army, Corps of Engineers
111 East 16th Street
New York 3, New York

Dear Sir:

Relative to your letter of June 17th and meeting in your office on September 15th with your Mr. Gofseyeff and our Mr. O'Connor in regard to proposed beach erosion control and hurricane protection of the area along Raritan and Sandy Hook Bays, between South Amboy and Highlands, N. J.:

The Central Railroad Company of New Jersey has no objections to this proposed project, providing the Railroad Company is not assessed for any portion of the cost of the construction or future maintenance. Cost, operation and maintenance of proposed railroad closure structures at Way Cake and Pews Creeks (CRR of NJ Bridge Nos. 4/87 and 6/36) should be borne by others and not the Railroad Company and detail plans and method of construction be subject to approval of the Chief Engineer of the Railroad Company prior to commencement of any work at these locations.

Construction of levees, fill, drainage structures, tide gates and railroad closure structures in connection with the project, shall not interfere with the operation of the Railroad Company's trains or facilities.

Very truly yours,

B. J. Minetti

○

EXHIBIT K - 2

2

PERMIT
68-30

October 23, 1968

Mrs. K. Marazzo

1968
(CR-AGL)

Mr. James K. Rankin

Project No. 32.01:420-451-855: Raritan Bay -
Sandy Hook Bay Cooperative Hurricane and Shore
Protection Project; Madison Township -
Permit 68-30: Sea Land Development Corp.

Your file with notation dated September 9, 1968
requesting report on meeting held September 6, 1968 with Sea
Land Development is attached.

Representation at the September 6, 1968 meeting
was:

State: Messrs. Rankin, Marrazzo, Kelly, Johnson.
Township: Township Engineer John Allair
Sea Land: President S. A. Telounis, Attorney
A. S. Kleimer

With reference to attached map dated September 11,
1968, the Sea Land case is summarized:

1. Sea Land purchased the upland area colored
"Green" from Wilson Avenue east to Margaret
Creek.
2. Sea Land proposes to purchase a riparian
grant for the combined "Red" and "Red
hatched" area in order to have a total land
area (upland plus riparian) of 17 acres to
meet local zoning requirements.
3. Sea Land proposes to build a seawall composed
of slag and clay core with stone revetment on
outshore side and berm. The heavy black line
shows the seawall location from Wilson Avenue
east to Margaret's Creek. The seawall berm is
to be 15' above mean sea level and Sea Land
is to fill behind it to same elevation. The
seawall would substitute for the protective
feature of the beachfill placed at this

Mrs. N. Marasco

October 23, 1961

-2-

location by the Army Engineers.

4. If the State conveyed its ownership of the riparian lands marked "Red" and "Red hatched", the title in fee would go to Sea Land, but the grant would reserve to the State an easement in perpetuity for public use of the "Red Hatched" area which would satisfy the public recreation benefits requirement of the federal beachfill project.
5. Sea Land has been advised that the State would also require beachfill placement in front of the seawall so as to establish a beach in fact. Sea Land has agreed to this subject to final accord upon establishment of the cost to the Corporation.
6. Sea Land has been advised that all discussions are at staff level for the purpose of reporting to higher authority for decision.
7. Sea Land has been asked to furnish survey data as the map attached is incomplete and has been advised that work-up of the riparian data cannot be made until such information is submitted.

In addition to the general outline of the case as noted above, the following specific items were noted at the September 6, 1961 meeting.

1. Sea Land was to fix the exterior grant line it needs to assemble 17 acres and submit for review. (This is shown on the attached map). Mr. Tsigounis said that the seawall location was fixed and would furnish bearings, distances and ties. Sea Land, also, would furnish other necessary survey information required for riparian investigation. This would include former riparian grant shown at west end of frontage which state finds incorrectly located and in fact outside the frontage under consideration.

Mrs. A. Marazzo

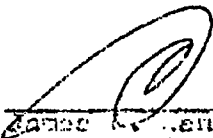
October 13, 1966

-3-

Sea Land has indicated a willingness to convey its interest in this former grant to the State in order to remove any future question. This is being investigated.

2. Mr. Tsigoiris stated that Sea Land was willing to place a beachfill outshore of the seawall for public recreational use, but the cost based on his information was a considerable item and he asked that the beachfill dimensions be reviewed. He was advised that this would be done.
3. It was emphasized that further advance in this case would depend on receipt of the survey information from the Sea Land Engineers.

JKA:ms
attachment


James C. Hamilton
Acting Chief
Navigation Bureau

cc: Mr. A. Scoppetuoia
Mr. F. Kelly
Mr. J. P. Marron
Mr. H. W. Bond

NL-RBS 000416

EXHIBIT K -3

3

MEMORANDUM

DATE May 20, 1970

TO: Director K. H. Creveling

FROM: Mr. James K. Rankin

SUBJECT: 68-131: Sea Land Development Corp; Riparian Grant,
Raritan Bay, Madison Township
✓ 32.01:420-156-855 Madison Township Cooperative
Hurricane and Shore Protection Project (1970)

68-131: On December 17, 1969, Council approved riparian grant to Sea Land with four conditions.

1. Applicant to deed back its title to that portion of the grant dated December 18, 1922 covered by its deed.
2. Applicant to convey a perpetual easement for a beach area of 2,808 acres of grant to be conveyed.
3. Applicant to create a beach acceptable to the U. S. Army Corps of Engineers to replace one constructed under its coast protection project.
4. Applicant to provide public access over its property to proposed beach area.

Meeting was held May 19, 1970 at New York District Office, Corps of Engineers to obtain Corps views on Conditions Nos. 3 and 4. Those present were Mr. Panuzio and Mr. Nersesian of the Corps and Mr. Wicker and Mr. Rankin of Navigation Bureau. The results of the meeting are as follows:

Condition No. 3: Beachfill

1. The new beach to be constructed outshore of the Sea-Land Scawall shall be equal in design to the Cooperative Project beachfill with 25' wide berm at Elevation 10 mean sea level, and frontal slope of 20 horizontal to 1 vertical. The insore line of the 25' wide berm shall be the "Toe of Slope of Proposed Seawall" line as shown on map of proposed Sea-Land grant as prepared under Case 68-131. The beachfill plan shall include appropriate fitting of the new beachfill into the existing beaches to the east and west of the Sea-Land Seawall.

Director K. H. Creveling

May 20, 1970

-2-

It is considered that the dry beach as measured from the inshore line of the berm to the project high water line, being the +2.1 mean sea level contour, will be equivalent to the authorized project beach in terms of Project Recreation Benefits.

2. The Navigation Bureau shall prepare contract drawings and specifications for the new beachfill and submit them to the Corps for approval in the same manner as local projects under cooperative projects are cleared. The Bureau project will be considered as an amendment to the Authorized Project and will have to be formalized by appropriate amendment to the Local Cooperation Assurances of the Authorized Project.
3. The State shall obtain and furnish to the Corps the perpetual easement covering a portion of the new beach area to be given to the State by Sea-Land as per Condition No. 2 under Case 68-131. It is understood that the area of this easement shall be the property owned by Sea-Land after the grant conveyance lying between the Toe of Seawall Line and the exterior (outshore) line of the riparian grant as shown on proposed grant map in Case No. 68-131. In addition, it is considered desirable that the Natural Resources Council by appropriate action dedicate or otherwise assure the existence in perpetuity of the portion of the new beachfill outshore of the proposed Sea-Land grant exterior line as a public beach with title remaining vested in the State.
4. When the contract drawings and specifications are approved by the Corps, the new beach shall be constructed by either the State or Sea-Land as agreeable to the State without any Federal participation. Pursuant to Condition No. 3 of Case 68-131, the project cost of beachfill construction shall be borne by Sea-Land. The State's engineering and inspection costs are considered part of the beachfill project cost and are to be included in the estimated project cost.
5. The new beach is to be maintained by the State and Madison Township as per Local Cooperation Assurances. The Sea-Land Seawall and the lands rearward of the seawall are the responsibility of the Owner.

Condition No. 4: Permanent Access Easement

1. The State shall obtain from Sea-Land and furnish documentary evidence of an easement in perpetuity for public access across the lands of Sea-Land to the new beach at three locations along the Sea-Land bayfront, such locations being compatible with the Sea-Land plan for development of the property rearward of the Sea-Land Seawall and subject to Federal and State approval and acceptance. The intent is to assure convenient public access

May 20, 1970

Director K. H. Croveling


-3-

to the beach and appropriate dispersion of beach population without inhibiting design for use of Sea-Land property.

Comments

1. The Contract Plans and Specifications will be prepared for submission to the Corps in order to advance this case.
2. Sea-Land will be advised of the conclusions reached by consultation with the Corps as to the Conditions under Case 68-131.
3. Joint field inspection with Corps will be arranged for near future to assure full mutual understanding based on direct observations in the field. The inspection will include the entire Authorized Project frontage as well as the Sea-Land portion.

JCR:ms


James K. Rankin, Chief
Bureau of Navigation

cc: Mr. Frank Kelly
Mr. A. Sceppetuolo
Mr. J. P. Marron
Mr. H. W. Boud
Mr. C. F. Wicker

EXHIBIT K - 4

4

MEMORANDUM

DATE October 19, 1970

TO: Deputy Commissioner Joseph T. Barber

FROM: Mr. James K. Rankin

SUBJECT: 68-131: Sea Land Development Corp.; Riparian Grant,
Raritan Bay, Madison Township

32.01:420-156-855: Madison Township Cooperative
Hurricane and Shore Protection Project (1970)


On October 15, 1970 you advised that Sea Land has proposed furnishing \$55,000. to reimburse the Federal Government for its expenditure in connection with placement of beachfill along the Sea Land bayfront property at Madison Township. It was understood that the offer was intended to remove Condition No. 3 of the four stipulated by Council in approving grant. The four conditions specified are:

1. Applicant to deed back its title to that portion of the grant dated December 18, 1922 covered by its deed.
2. Applicant to convey a perpetual easement for a beach area of 2.808 acres of grant to be conveyed.
3. Applicant to create a beach acceptable to the U. S. Army Corps of Engineers to replace one constructed under its coast protection project.
4. Applicant to provide public access over its property to proposed beach area.

Comment

1. The \$55,000. represents only the Federal investment as estimated by the Corps of Engineers. The State and Madison Township would have to be compensated also in amount of \$60,000. based on the Corps computation.
2. In order to report the offer to the Council for its decision, it would be necessary for Madison Township to make a formal request and recommendation.
3. The Council action, if favorable, would be subject to formal application to and approval by the Corps of Engineers.

JKR:ms


James K. Rankin, Chief
Bureau of Navigation

NL-RBS 000422

November 17, 1970

Meeting Notes

RE: 68-131: Sea Land Meeting November 1970 in Deputh
Commissioner J. T. Barber's Office

Present: Mr. Joseph Barber, Mr. James K. Rankin, Mr. Tsigounis,
Mr. Robert J. Hartlaub, President Crestview Lawyers
Service.

1. Joseph T. Barber read James K. Rankin's memorandum dated October 19, 1970. Mr. Tsigounis appeared ready to accept Council terms, but considered \$115,000. too great an investment. Was asked if he wished to express agreement sufficient to warrant preparing plans and specifications for Item No. 3 - the Beach Indiated not ready.
2. Mr. Tsigounis said in view of the ramifications in the case, was thinking that best solution would be to sell or lease the Sealand Property to the State. Stipulated, however, would want his cost.
3. Meeting adjourned to meet in a week or so. Mr. Hartlaub to send Joseph T. Barber letter on legal points raised by him.

JKR:ms


James K. Rankin, Chief
Bureau of Navigation

MEMORANDUM

DATE November 24, 1970

TO: Mr. Joseph T. Barber

FROM: Mr. James K. Rankin

SUBJECT: 68-131: Sea Land Development Corporation; Riparian Grant,
Raritan Bay, Madison Township

With reference to our conversation November 23, 1970 on beach design acceptable to the Army Engineers, enclosed is copy of memo dated May 20, 1970 describing the results of meeting held May 19, 1970 in the New York District Office. The description of the required beach starts at bottom page one and continues on page two and constitutes the basis for beach design discussion with Sea Land.

If Sea Land is willing to accept Council's Condition No. 3, then we would be in position to proceed with plans and specifications for formal review by the Corps.


James K. Rankin, Chief
Bureau of Navigation

JKR/die

James K. Rankin

December 4, 1970

See Below

Mr. James K. Rankin

68-131: Sea Land Development Corp; Riparian Grant,
Maritan Bay, Madison Township

Meeting was held 10:00 A.M. December 3, 1970 in Mr. Barber's Office as extension of earlier meeting held November 17, 1970. Those present: Messrs. Barber, Tsigounis and Rankin.

For reference attached are:

1. Copy of November 17, 1970 Meeting Notes.
2. Copy of James K. Rankin's memorandum dated November 19, 1970.
3. Copy of James K. Rankin's memorandum dated November 24, 1970.
4. Copy of James K. Rankin's memorandum dated May 20, 1970.

On December 3, 1970, Mr. Tsigounis indicated Agreement to pursue preparation of plans and specifications in accordance with Condition No. 3, Item No. 1 as set forth in memorandum dated May 20, 1970. In view of this circumstance the meeting was adjourned to Navigation Conference Room for detailed discussion with Messrs. Tsigounis, Maxxon and Rankin present.

At the second meeting on December 3, 1970 Mr. Tsigounis was furnished a copy of the May 20, 1970 memorandum and the conferees reviewed Items 1 through 5 under Condition No. 3 in detail and also examined a copy of Case 68-131 Grant Map referred to in Item No. 1.

Mr. Tsigounis indicated that the five items as written were satisfactory and he was agreeable to preparation of the contract drawings etc. by the Navigation Bureau. Mr. Rankin advised that this work would be undertaken as promptly as possible.

Mr. Tsigounis is to be notified when the plans and specifications are completed. Joint Meeting is then to be held to discuss the plans and estimated costs. Mr. Tsigounis is to be furnished copies so that he may make his own cost estimates and consult with his people.


James K. Rankin

December 4, 1970

-2-

At this point, if mutually satisfactory, Navigation Bureau will submit to Corps of Engineers for review pursuant to Item No. 2. To support such action, Mr. Tsigounis will furnish affirmative statement on the four conditions placed by Council in connection with Riparian Case No. 68-131.

JPR:ms
attache:ms



James R. Rankin, Chief
Bureau of Navigation

Deputy Commissioner J. T. Barber
Director J. H. Creveling
Mr. Frank Kelly
Mr. A. Scoppetuolo
Mr. J. P. Harron
Mr. H. W. Bond

EXHIBIT K - 5

5



BOX 70-C, R.D. NO. 1
OLD BRIDGE, N.J. 08857

Township of Madison

MIDDLESEX COUNTY, N. J.

Conservation Commission

REPLY TO:

168 B AMBOY ROAD
R. D. 1
MATAWAN, N. J. 07747

September 29, 1972

Mr. A. W. Price, Chief
Solids Waste Management Div.
Dept. Of Environmental Protection
Box 1390
Trenton, N. J., 08625

Dear Mr. Price,

This is to confirm our telephone conversation regarding the land fill operation being conducted on the Laurence Harbor beach front on Raritan Bay, in Madison Township.

I am enclosing two photographs taken at the site of this operation which show in some detail the problems to which I referred.

Photo No. 1 is of a man recovering lead metal from the recently dumped slag used for the land fill. This slag, probably from the lead melting operation of National Lead in Perth Amboy would also contain other heavy metals and metal sulphates normally associated with the raw material. As can be seen the land fill has passed the high tide mark and the dumping is taking place right into Raritan Bay therefore these metals and their soluble salts pose an additional threat to increasing the pollution in the bay.

Photo No. 2 shows the removal of an ingot of solid lead from this same slag dump. I estimate the ingot weight to be about one half ton. While all the slag is not solid lead there is a substantial amount in almost all the pieces.

I feel that this land fill operation constitutes a series of improper operations, some that I may not have specifically outlined. I would appreciate receiving a copy of any report your office prepares concerning the land fill.

Very Truly Yours,

George A. Koshler
George A. Koshler
Chairman

EXHIBIT K - 6

6

State to probe dumping of lead

By ROBERT WINDREM
News Tribune Staff Writer

MADISON TOWNSHIP — The state Department of Environmental Protection has agreed to send a field representative to the Laurence Harbor beachfront to investigate the dumping of lead slag along the water line.

George R. Koehler, chairman of the township's Environmental Commission, said at last night's township council meeting that the department's Division of Waste Management has promised to send a representative to investigate the practice of trucking lead slag from Perth Amboy to Laurence Harbor, where it is dumped.

Koehler said the slag, large mound-shaped blocks of lead residue, has been dumped indiscriminately along the water line, making it unusable for recreation. To substantiate his story, Koehler said he has sent photographs of the dumping to A. W. Price, the division chief.

He said the photographs were taken Sept. 18, and an inspection of the area Sunday showed that more slag had been dumped on the same section of the beachfront, which is privately owned. It lies just south of the township's public beach in Laurence Harbor.

"This slag, probably from the lead smelting operation of National Lead in Perth Amboy, would also contain other heavy materials and metal sulphates

associated with the raw material," Koehler said, adding that the metals and soluble salts pose an additional threat to increasing pollution in the bay.

"The life expectancy of a fish in lead-polluted waters is 24 hours," Koehler said. "A mackerel on the gill of the fish and the fish suffocate. This is particularly bad in light of the fact that

the boy is cleaning itself, as evidenced by the fact that people are starting to catch fish off Perth Amboy."

Koehler added that environmental effects aside, the township would be spending wasted money on Great Acres applications if the practice is allowed to continue and the present damage allowed to remain.

He meets the in State, interest period. Stere sludge shore.

The New Tribune

WOODBIDGE, N. J., TUESDAY, OCTOBER 3, 1972

The dumping of lead slag

lated with the raw material, he said, adding that the metals and salts pose an additional threat to fishing pollution in the bay. He said the life expectancy of a fish in lead-laden waters is 18 to 24 hours. "A mucus forms on the gills of fish and the fish suffocate. This is particularly bad in light of the fact that

the bay is cleansing itself, as evidenced by the fact that people are starting to catch fish off Perth Amboy."

Kochler added that environmental effects aside, the township would be spending wasted money on Green Acres applications if the practice is allowed to continue and the present damage allowed to remain.

He added that the commission, which meets tonight, intends to send a letter on the matter to U.S. Attorney Herbert J. Stern, based on the fact that the bay is an interstate waterway and under the jurisdiction of the Refuse Act of 1936. Stern used the Refuse Act to halt the sledge-flushing practices of more than 30 Shore municipalities earlier this year.

EXHIBIT K - 7

7

MEMO

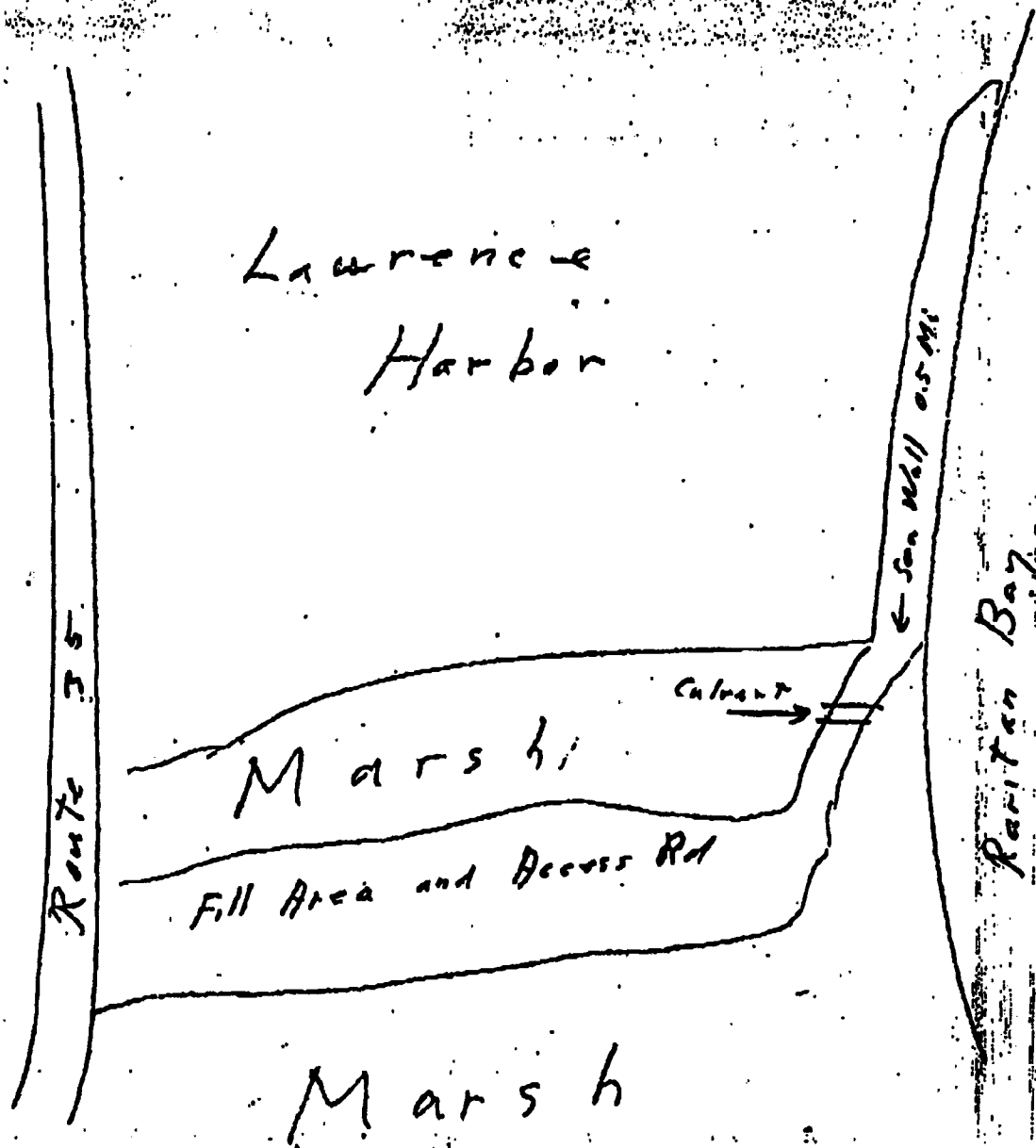
STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

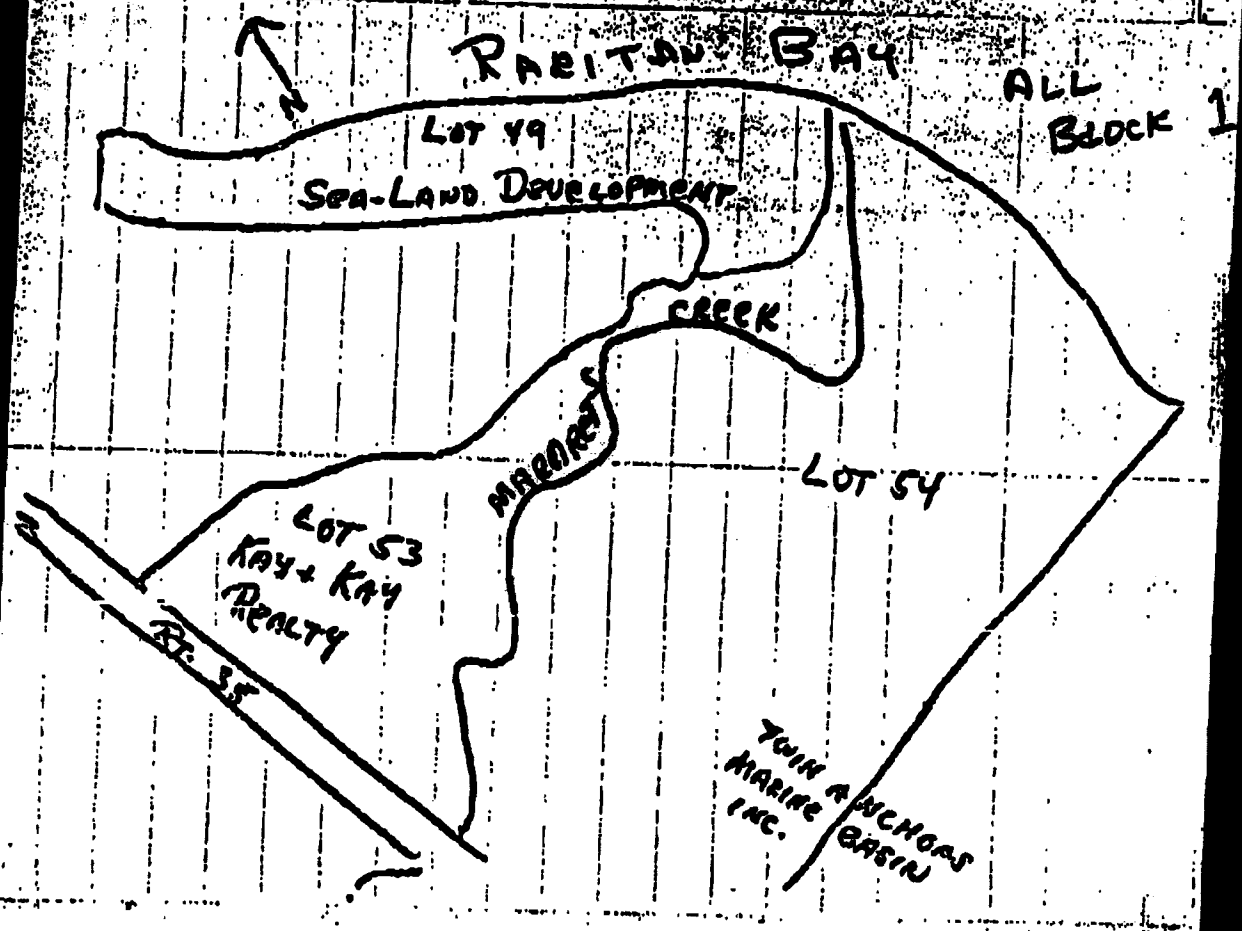
TO: Fik

FROM: C. E. Gingrich

DATE: 10-9-72

SUBJECT: Slag Deposit - Laurence Harbor Beach Front
on Raritan Bay, Madison Twp. Middlesex Co.





EDgewater, N.J.

Block 1

Lot 49

Block 1

**TWIN ANCHORS MARINE
- BASIN INC.**

LOT 54

12 LIBERTY ST.

FORDS, N.J.

Block 1

Rose Ludwig

LOT 53

LINDA LEE

12 LIBERTY ST.

Fugas, N. 5.

MEMOSTATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

TO: Director Charles M. Pike
FROM: Mr. Charles E. Gingrich
DATE: October 5, 1972
SUBJECT: Slag disposal, Laurence Harbor beach front on Marion Bay, Madison Township, Middlesex County.

Mr. Koehler, Chairman of Madison Township Conservation Commission has brought to our attention the use of slag containing lead and other heavy metals in the construction of a sea wall along 1/2 mile of Laurence Harbor beach front and an access road to the sea wall through a tidal swamp. Our Bureau has investigated this and we feel that because of the nature of this material and where it is being deposited that your sections of our Department would be vitally interested.

Attach is a copy of Mr. Koehler's letter and our reply. Also for your information is a copy of a recent newspaper article.

We expect to have lot and block numbers later this week should you require them. A sketch is attached showing general location.

CEO:ls

RECEIVED
OCT 9 1972
BUREAU OF WATER POLLUTION CONTROL

RECEIVED

OCT 9 1972

N.J. STATE DEPT. OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER POLLUTION CONTROL

EXHIBIT K -8

8

home | my new jersey | people | business | government | departments

new jersey
department of environmental protection
OPRA New Jersey
Open Public Records Act

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site search reports by category reports search help

Inspection Summary Report for OLD BRIDGE TWP @
NORTH OF MARGARETS CREEK (U) - Activity Number
INV 040001

Nov 07, 2012 11:34

NOTE: The information contained in this report will be limited to the date each program began using the Department's integrated database, NJEMS. The programs began using the system for this information as follows: Air - 10/1998; Hazardous Waste - 1/2000; Water - 7/2000; TCFA - 12/2001; Land Use 12/2001; DPCC - 1/2002; Solid Waste - 1/2002; Right To Know - 3/2002 and Pesticides - 4/2002; Site Remediation - 3/2003 and Radiation (limited information) - 7/2006. For complete information prior to these dates, please submit an official OPRA request form to the Department. If printing this report, select landscape orientation. For a list of terms and definitions, click on the following link: <http://www.state.nj.us/dep/infocview/enforcement.html>

Disclaimer: Only final inspection reports are listed in this report. Inspections for which a report has not been finalized by the Department will not appear in this report. Also, inspections which yield violations but where the inspected entity has not yet been notified of the violation are not listed in this report. For inspections indicating Out of Compliance, this means that violations were observed during the inspection, based on facts and information known to the Department at the time of the inspection. Errors or omissions in the factual basis for any violation may result in a future change in classification as a violation when such information becomes known.

Activity Number: INV 040001 Inspection Type: Incident Investigation Program Interest ID: U642

Inspection Start Date: 02/18/04 End Date: 02/18/04 Lead Investigator: Nothstein, David

Program Interest Name: OLD BRIDGE TWP @ NORTH OF MARGARETS CREEK (U)

Address: RT 35 Old Bridge Twp NJ 08857 County: Middlesex - Old Bridge Twp

Block(s) and Lot(s): Block 1 Lot 53, Block 1 Lot 54.11, Block 1 Lot 54.12, Block 1 Lot 64

Comments:

Site is north of Margarets Creek between Rt 35 and Raritan Bay.
Gate locked, Walked over berm next to gate and down road which bisects upland part of property towards bay.
Saw the following: street sweepings; asphalt; concrete; lumber; brush; tree parts; a steel tank and a few tires.
All appeared to have been dumped illegally a year or more ago. Some was several years old.
On 2/19/04 I met with Albert Koehl, Superintendent, Old Bridge DPW. He explained that the site was previously owned by the Sewer Authority which still has an easement over the site.
The site is now owned by Old Bridge which put an end to illegal dumping there with a berm and gate.
He explained that Old Bridges Engineer John Vincenti is looking into cleaning up the site which will be a major project.

Old Bridge has a history of working with this office to clean up Township property where promiscuous dumping has occurred.

Called Mr. Koehl and informed him that a Notice of Violation will be issued to the Twsp. Mr. Koehl indicated that he would provide a written plan for clean-up within two weeks from the date of this report.

Subject Item: SW34 0 - Unpermitted/Illegal Activities

Seq. #	Requirement Description	Compliance Status	Compliance Comments	Grace Days	Non Minor Reason	Requirement Source
6805	UNPERMITTED/ILLEGAL SOLID WASTE FACILITY ACTIVITIES	Heading				Rules
6815	No person shall engage or continue to engage, unless exempt by N.J.A.C. 7:26-1.1, 1.7 or 1.8 in the disposal of solid waste in this State without first having filed a completed application for and received approval of a SWF Permit. [N.J.A.C. 7:26-2.8(e)]	Out of Compliance	Failure to apply for and receive department approval prior to engaging in solid waste disposal. Specifically: Solid Waste on Township Property in area of Margaret Creek			Rules

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Department of Environmental Protection
P. O. Box 402
Trenton, NJ 08625-0402

Last Updated: June 15, 2012

Exhibit L

March 12, 2012

2007-1973-07

Ms. Tanya Mitchell
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007

RE: Raritan Bay Slag Superfund Site
Comments to the National Remedy Review Board

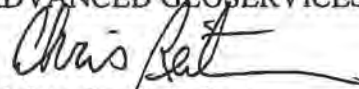
Dear Ms. Mitchell:

On behalf of NL Industries, Inc. (NL), Advanced GeoServices Corp. (Advanced GeoServices) is submitting the attached comments for consideration by the National Remedy Review Board (NRRB) in its review of the Raritan Bay Slag Superfund Site. As requested, the comments have been limited to 10 pages with NL's earlier comments on the RI, provided in a letter to EPA on February 20, 2012, attached for the NRRB's convenience. In addition to sending these comments to the NRRB, we also request that they be included in the Administrative Record for the Site.

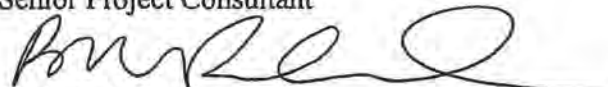
We are happy to respond to any questions on the comments from either EPA or the NRRB and welcome the opportunity the approach to the Site remediation at any time.

Respectfully submitted,

ADVANCED GEOSERVICES CORP.



Christopher T. Reitman
Senior Project Consultant



Barbara L. Forslund, P.E.
Consultant

CTR:BLF:vm

Enclosures

cc: Frank Cardillo, USEPA (without attachment)
Angela Carpenter, USEPA (without attachment)
Kevin Lombardozzi, NL Industries (without attachment)
Courtney Riley, NL Industries (without attachment)
Chris Gibson, Archer & Greiner (without attachment)



NL Industries, Inc. Comments to National Remedy Review Board
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NL Industries, Inc. ("NL"), one of the stakeholders for the Raritan Bay Slag Superfund Site (the "Site"), appreciates the opportunity to provide its comments to the National Remedy Review Board ("NRRB"). NL understands that the NRRB's purpose is to evaluate the proposed remedial decisions for consistency and cost-effectiveness. NL welcomes the NRRB's review of the proposed remedial alternatives recently identified in the Feasibility Study ("FS") for the Site. NL believes that the most appropriate remedial alternative was not included and that some aspects of the presented alternatives are inconsistent with U.S. Environmental Protection Agency ("EPA") guidance as well as approaches and standards used at other sites, are not supported by the data, and do not reflect an implementable or cost-effective approach, both in dollars and community impact, to addressing any human health or ecological risks that may exist at the Site.

Site Contamination and the Most Appropriate Remedial Alternative for the Site

Contamination at the Site relates primarily to use of slag "pots" (large rounded lumps of solidified slag, each weighing approximately 450 pounds) in construction of a seawall and jetty during the late 1960s to early 1970s by a now defunct former owner/operator of the property. A small volume of broken plastic automobile battery casings also were found in a few areas of the Site. Although this material has been present at the Site for more than 40 years, the data shows that the contamination has not migrated far from the principal source areas and its presence has created little risk to human health. EPA's Human Health Risk Assessment ("HHRA") reports that any human health risk at the Site is relatively minimal, and EPA has described in recent phone calls with us that human health risks do not drive the need for the remedy. Moreover, as will be discussed below, when certain errors in the HHRA are corrected, the analysis actually shows there are no unacceptable human health risks at the Site under present conditions, including if the beach were reopened. Ecological risks are minimal but are the driver of the remedy at this Site.

For all of the reasons discussed in the following pages, NL submits to the NRRB that the most appropriate remedy for this Site is a phased approach that essentially divides the Site into two Operable Units ("OU") targeting the principal sources of slag and battery casings, with a third phase of monitoring and further risk assessment on any residual risks related to the CERCLA sources after the principal sources are removed. Such a division and staged approach is desirable because the Site is located in separate municipalities (Old Bridge: Seawall/Margaret's Creek sector and Sayreville: Jetty sector), special permitting and design challenges in the Jetty Sector, and the need for further evaluation of ecological risks in the Jetty sector. It is also necessary to minimize detrimental impacts to the Old Bridge community of the construction project itself.

Phase I/OU-1 would address the Seawall and Margaret's Creek sectors, and would consist of the following activities:

- Excavate the seawall source materials plus one foot of underlying soil;
- Excavate and dewater the near-shore sediments with lead concentrations exceeding the EPA's proposed ecological sediment Preliminary Remediation Goal ("PRG") of 232 mg/kg applied appropriately over the foraging area to a depth of one foot (a depth below the biologically active zone of benthic organisms) and replace the excavated sediments with clean material that will function as a cap for the limited amount of underlying contamination;



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- Excavate the beach above the high tide line and upland soils with lead concentrations above 400 mg/kg (New Jersey Department of Environmental Protection ("NJDEP") Residential Direct Contact Soil Remediation Standard) to a depth of one foot and replace the excavated soils with clean fill;
- Excavate source materials in the Margaret's Creek Sector plus one foot of soil below the source materials and replace with clean fill;
- Excavate the soils/sediments in the Margaret's Creek Sector that are above the appropriate lead-based PRGs to a depth of one foot and replace with clean fill;
- Consolidate excavated materials into a containment area in the Margaret's Creek uplands and install a multi-media cap with institutional controls;
- Restore the seawall, beach and soil/sediment excavation areas; and,
- Monitor the sediments in impacted areas beyond and beneath the excavation areas for five-year period.

Phase 2/OU2 would address the Jetty Sector, and would consist of the following activities:

- Conduct additional study necessary for design and permitting, including a detailed evaluation of sediment capping options; conduct an ecological risk assessment and establish appropriate lead PRGs for sediments in Area 7 that were not addressed in the existing ecological risk assessments;
- Excavate the source material and sediments that can be reached with conventional equipment on firm ground and dewater the sediments; replace the excavated sediments with clean fill;
- Excavate soils above 400 mg/kg of lead on beach area; replace with clean fill
- Consolidate the excavated material into a second containment area and install a multi-media cap with institutional controls;
- Cap in-place sediments with lead concentrations above lead PRG that cannot be removed cost-effectively using conventional methods; and,
- Monitor the sediments in impacted areas beyond excavation and capping areas for five-year period.

The total anticipated cost of these two phases is around \$25 million and would involve the excavation and on-Site containment of approximately 40,000 cubic yards of material.

The third phase would include conducting appropriate human health and ecological risk assessments using post source material removal data to determine if there are residual risks from the CERCLA sources. Based on the existing data, it is very likely that there will be no unacceptable risks after the primary sources are removed. However, if there are, decisions can be made at that time to address those risks.

EPA's FS Should Include a Phased/OU Alternative Focusing First on Primary CERCLA Sources

Even though NL and Old Bridge Township have been discussing this type of approach with EPA for over a year, none of the alternatives evaluated in the FS consider any type of phased/primary source removal alternative. However, this type of alternative is the right approach for the Site.



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NL has been working closely with Old Bridge Township to develop a proposed cleanup plan that is fully protective of public health and the environment, while avoiding unnecessary cost, disturbance, and detrimental impact on the community. The conceptual plan generally consists of removal of primary CERCLA source materials similar to the approach described above. NL's and Old Bridge Township's environmental consultants have presented their conceptual plan for the first phase of remediation to both EPA and the Citizens Advisory Group and received favorable feedback. Although this kind of primary source removal approach has been discussed at several EPA and public meetings in Old Bridge Township, none of the FS remedial alternatives include an alternative embodying that approach. Instead, the FS remedial alternatives involve the excavation of between 151,000 and 277,000 cubic yards of material and the treatment and off-Site disposal of all or a significant portion of that material, with some alternatives allowing a limited amount of soil/sediment to be contained on-Site in multiple on-site containment cells with side and bottom liners and leachate collection systems at costs ranging from \$97 million to \$229 million. In these alternatives, the vast majority of the volume is related to sediments and soils, not the slag or battery casings. In other words, EPA is advocating remedial alternatives that are approximately \$80 million to \$200 million more than the phased/primary source removal approach advocated by NL and Old Bridge. As discussed in more detail below, such a remedy is an order of magnitude bigger than what is needed or justified for this Site.

The FS remedial alternatives are far more costly, both in dollars and detrimental community impacts, than necessary because of failure to restrict the remedy to contaminants associated with the slag and battery casings, ignoring of background sampling data, selection of unrealistically low PRGs and unprecedented use of so-called "unified PRGs" (i.e., the same PRG for both sediment and soil). EPA also failed to give appropriate weight to the impact on the community that would result from their proposed remedial alternatives, which would take as long as four years of field work to complete and involve as many as 102,000 truck trips through the local roads of Old Bridge.

EPA's Proposed Remedial Alternatives Are Not Necessary to Protect Human Health

In the HHRA, EPA concluded that there are unacceptable human health risks for the following scenarios: (1) adult and child anglers consuming fish or hard clams (risks from non-lead constituents); (2) residents using groundwater as drinking water (risks from non-lead constituents); (3) female construction/utility workers of child-bearing age (lead risk only); and (4) child recreational users in the beach area (lead risk only). However, all of these alleged risks are overstated based upon overly-conservative analysis or faulty data. In a letter dated February 20, 2012, NL provided technical comments on what NL saw as major deficiencies in the data collection and in the RI that affected remedy selection (copy attached). While EPA did not undertake any additional sampling and made no corrections prior to issuing the FS, in subsequent communications with NL, EPA acknowledged that the human health risks described in the HHRA are based upon the most conservative parameters. EPA also agreed to review the risk assessment and data flaws. Nevertheless, NL is compelled to raise these issues with the NRRB to highlight the rush to judgment at this Site and the lack of support for many of the conclusions in the RI and FS.

NL submits that when EPA re-evaluates the technical points raised in NL's comments to the RI, it will become clear that there presently are no unacceptable human health risks at the Site. Moreover, even if the risks calculated in the HHRA are deemed accurate by EPA after its review, these risks would be eliminated by implementation of the phased/primary source removal approach discussed above.



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Thus, the question squarely presented by the FS is whether ecological risks realistically exist from slag/battery casing-related contamination that justify spending an additional \$80 million to \$200 million as proposed in the FS. NL believes that the answer to this question is no.

The FS Remedial Alternatives Target Soil/Sediment Not Impacted by Source Materials.

EPA acknowledged in the FS that "CERCLA does not require contaminants not related to site activities to be addressed as part of the site remedy" (FS at ES-9). EPA identified lead, arsenic, and, to a minor degree, copper as the contaminants of concern ("COCs") and purported to base its identification of the soil/sediment targeted for removal upon the co-location of those COCs (primarily lead and arsenic). However, as lead and arsenic occur naturally, and have numerous anthropogenic sources other than the slag, it is not appropriate to automatically assume that all lead and arsenic at the Site is associated with the slag. Rather, only co-located lead and arsenic present in a ratio consistent with the lead/arsenic ratio of the slag can be deemed associated with the slag.

The RI and FS both acknowledge that the majority of contamination coming from the slag results from mechanical weathering. EPA concluded that some leaching may be occurring (however, see the discussion below), but that leaching could only be at very small concentrations compared to the main weathering pathway for the COCs. Therefore, only co-located lead and arsenic present in a ratio consistent with the lead/arsenic ratio of the slag can be deemed associated with the slag and cleaned up under CERCLA.

The RI presents the analytical results for three composite slag samples collected in 2011, from which a representative ratio range of lead/arsenic concentrations can be ascertained. Based on Table 5-1 in the RI, the average lead/arsenic ratio in the slag is 24. The Slag Characterization study (Appendix B of the FS) presents the results of 17 additional slag samples with the lowest observed ratio being 7. Samples with substantially lower lead/arsenic ratios (i.e., where high arsenic levels are not matched by high lead levels) are most likely associated with non-slag sources of contamination. This understanding is crucially important because a large portion of the soil/sediment volume that EPA proposes for remediation has low lead/arsenic ratios showing that it is not associated with the CERCLA source. For example, there are significant areas of proposed excavation required under the FS where arsenic exceeds its PRG, but lead does not exceed its PRG, and the lead/arsenic ratio is inconsistent with a slag source. Over the more than 150 years of human occupation of the area, there are myriad potential sources of arsenic contamination, including the extensive use of arsenic-containing pesticides in connection with farming and orchards, and the use of pressure-treated lumber treated with chromated-copper-arsenate in docks and marinas. NL provided information about these anthropogenic sources in its February 20th letter (attached) and they are apparent from EPA's Whale Creek background data (discussed below).

An Area Weighted Lead PRG Should Drive the Remedy

To ensure compliance with CERCLA, the best approach would be to use the lead PRG to identify soil/sediment for remediation. This way, only areas with high lead indicative of the CERCLA sources would be addressed. Arsenic and copper truly associated with the slag still would be captured along with the lead. In fact, under this approach, all arsenic associated with the CERCLA source above 33 mg/kg (except for sediments surrounding four isolated, non-contiguous samples, and which are not source-related) would be incidentally removed. Limiting the remediation to soil/sediment where lead exceeds the appropriately applied, area-average PRG would limit the remediation to contamination associated



with Site activities in accordance with CERCLA's intended purpose and EPA's standard practice at other sites. The effect would be to substantially decrease the volume of near-surface soil/sediment to be remediated by over 150,000 CY, a reduction of approximately 57%. Stated another way--only 43% of the volume referenced in the FS is possibly driven by the slag source and 57% is not related to the CERCLA source.

The Use of a "Unified" PRG For Arsenic is Not Appropriate at this Site and is Inappropriately Low

EPA should reevaluate the use of one "unified" PRG for arsenic for the entire Site, which is large and diverse. If remedial decisions are to be made on the basis of such a single, unified arsenic PRG, then a more appropriate PRG for arsenic needs to be selected.

The FS Arsenic PRG is Inappropriately Low Compared to Background Data and Ecological Screening Levels

Sampling in the Whale Creek area that EPA selected as background for much of the Site produced an arsenic background level of 46 mg/kg. (A different arsenic background level applies to submerged sediments in the bay.) While NL understands that EPA was required in its ecological risk assessments to evaluate risks independent of background conditions, EPA should have given significant consideration to background arsenic levels when remedial alternatives were evaluated in the FS. As EPA itself stated in the FS, it simply is not appropriate to use a CERCLA cleanup to remediate soil/sediment to below background. Cleaning up a small area to below background levels will accomplish little as levels ultimately will rise again from non Site-related sources to reach equilibrium with surrounding areas.

In the FS, EPA cited the NJDEP Residential and Non-Residential Direct Contact Soil Remediation Standards of 19 mg/kg for arsenic (FS at 2-16). However, those standards are generic state-wide background levels, and should not be given precedence over Site-specific background levels. EPA also calculated an ecological risk-based PRG of 20 mg/kg for arsenic in soil, but that too was generic rather than Site-specific as it was literature-based (FS at 2-18).

For arsenic in sediment, EPA selected a PRG of 15 mg/kg based upon Site-specific submerged clean sediment background values. However, the background samples upon which EPA relied were from a clean area of submerged bay sediments that were not characteristic of a large volume of on- and near-shore sediments at the Site. Thus, while that background level may be appropriate for bay sediments with a low percentage of organics, it is not appropriate for other sediments at the Site. Other sediments are situated similarly to those found in the Whale Creek background area, and so the 46 mg/kg background level is appropriate for those sediments.

With regards to soils, the FS arsenic PRG is inconsistent with conservative risk-based screening levels developed by EPA and NJDEP to protect wildlife. EPA has acknowledged that its proposed remedial alternatives for the Site are driven by perceived ecological risks, but the 15 mg/kg arsenic PRG is far lower than the EPA's and NJDEP's soil screening criteria, which themselves are conservative. EPA's Ecological Soil Screening Levels (OSWER Directive 9285.7-65, March 2005) for arsenic are 43 mg/kg for birds and 46 mg/kg for mammals – three times higher than the unified PRG for arsenic used in the FS. NJDEP has adopted the same values as its Ecological Screening Criteria for soil. Arsenic present at concentrations below these values are not considered to pose ecological risks.



Use of a "Unified" Arsenic PRG For All Media in All Site Areas is Inappropriate

The EPA chose the most conservative of all areas, 15 mg/kg submerged bay sediment background, as what it called a "unified PRG" for arsenic – a PRG intended to apply across the entire Site and all environmental media. NL, which has been involved in metals remediation projects at numerous sites across the nation, has never seen a so-called "unified" PRG used at any other Site. It is not consistent with standard EPA practice and is not appropriate at a large and complex site like this one.

EPA attempts to justify its unified PRG concept on the basis that there is mixing of the soil and sediment through tidal and wave action and storm events (see FS at 2-19). However, the notion that beach and creek sediments, as well as upland soils, are virtually identical in all respects to submerged bay sediments is highly implausible. Moreover, that a major nor'easter or hurricane may hit the area for a day or two once every five or ten years does not render upland soils, or even the beach and creek sediments, identical in nature to the bay sediments. Indeed, EPA's own background sampling resulting in identification of background levels three times higher in the adjacent Whale Creek area compared to the bay sediments belies EPA's premise.

Use in the FS of a unified arsenic PRG of 15 mg/kg also is inconsistent with the arsenic PRGs chosen by EPA in 2009 for the Horseshoe Road Superfund Site. The Horseshoe Road site is located just 10 miles away along the Raritan River, which flows into the Raritan Bay close to the Site. There, the EPA adopted an arsenic PRG of 32 mg/kg for exposed sediments, 100 mg/kg for river sediments and 160 mg/kg for sediments submerged in marsh areas. For EPA to recently select such PRGs for a site just a few miles away with a similar ecological environment and then choose a much lower "unified" PRG for this Site, is troubling. We note that EPA also has selected higher arsenic PRGs for other marine environment sites. At the Harbor Island site in Washington, for example, EPA used an arsenic PRG of 57 mg/kg.

In short, EPA's selection of a "unified" arsenic PRG is inappropriate and results in dramatic overestimation of the volume of soil/sediment that should be targeted for remediation. EPA should select new arsenic PRGs appropriate to the various areas and media at the Site, which should take into account Site background, EPA/NJDEP ecological screening levels and PRGs selected at other sites.

EPA's Ecological PRG Derivations Are Unclear and Potentially Flawed

Since it is clear from the RI/FS and EPA communications that ecological risk is driving the multimillion dollar remedy at this Site, a careful review of the data, analysis and conclusions must be made before EPA issues a proposed plan for the Site. EPA has derived ecological PRGs based on a mixture of Site-specific and literature-based data and assumptions (Appendix D). We have identified several technical issues with EPA's PRG calculations that have a direct, linear effect on the PRG selected:

- EPA makes adjustments for moisture content in its arsenic PRG derivation that have a significant impact on the final PRG but does not provide details on which moisture content was selected and on what basis;
- We were unable to replicate EPA's derived Site-specific uptake factors that were at the basis of several ecological PRGs;
- EPA assumes that the most toxic form of metal is the only form present and then selects several toxicity values (e.g., the arsenic mammalian TRV) which are much lower than toxicity values previously used by EPA to derive conservative soil screening levels (Eco-



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- SSLs), resulting in several PRGs that are below EPA's own conservative ecological screening levels; and,
- EPA assumed that all selected wildlife receptors are exposed only to Site media, even though foraging areas of several receptors (i.e., kestrel, fox, goose, and mink) are significantly greater than the entire Site.

In addition, the PRGs should be used to determine excavation limits in a manner consistent with the way they were derived, i.e., as an average over the applicable species' foraging area and factoring in the depth that the food source is present.

Bottom/Side Liners and Leachate Collection Systems for On-Site Containment of Materials Are Unnecessary

Inclusion of requirements for bottom and side liners for containment cells and leachate collection systems adds needless expense to the proposed remedial alternatives with no additional risk reduction. EPA apparently believes that the source materials will leach metals into groundwater or will leach in the event of a flood condition in the vicinity of the containment cells. However, as NL pointed out to EPA in its February 20th written comments (attached) and in subsequent communications, the surface water and groundwater data upon which EPA relied were improperly collected. Subsequent surface water samples that were not included in the RI or discussed in the FS showed only very low metals levels indicative of a lack of leaching. EPA has acknowledged the problems with the surface water and groundwater data, but asserts that laboratory test results specific for leaching also showed a propensity (albeit very low) for leaching under conditions thought to simulate that composition of the bay waters that currently come into contact with the slag. However, none of the tests reflect the actual conditions that would exist in the capped containment cells. A properly constructed capped containment cell, which would be constructed in the 100 year flood plain, would not allow the consolidated materials to come into contact with rain or bay waters similar to current conditions, except in extraordinary flooding circumstances. Even if a minuscule amount of metals leached from the materials under such extraordinary circumstances, the dissolved metal would re-precipitate as soon as it contacted the surrounding soil, preventing its movement from the cell.

Advanced GeoServices, NL's consultant, has extensive experience with active and inactive industrial lead sites throughout the United States. Advanced GeoServices has designed capped landfills with no required bottom liner at the Jack's Creek Superfund Site, Marjol Battery RCRA Site, the Revere Site, and many other sites. At most of these sites the materials would have likely leached at extremely low levels, similar to the materials at the RBS Site. Nevertheless, EPA determined that a bottom liner did not add any significant degree of protectiveness to the remedy, the materials could be reliably contained, and there was not a significant reduction in toxicity, mobility, or volume associated with the liners and collection. The same is true at this Site.

Further, Advanced GeoServices and NL also have experience at sites like the Gould Superfund Site, Portland, Oregon, where a bottom liner was used to create a cell for containment of waste. Almost immediately following closure of the cell, no water drained to the leachate collection system. This experience helped to demonstrate that a leachate system is not necessary for soil materials with minimal void space that are capped to prevent infiltration of rainwater.



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Conditions expected at the Site following a capping and on-Site containment remedy would be considerably different than a municipal waste landfill where a bottom liner is required. There will be no municipal waste to create acidic conditions, and groundwater at the Site has a measured pH between 5 and 6 – much less acidic than the acetic acid used in the TCLP test to represent landfill conditions, which had a pH of just 2.8. If flooding does occur in the vicinity of the cell, such water would also not have a pH that would cause leaching. Designing a remedy with a bottom liner, leachate system and/or pre-disposal treatment to meet a condition that is never expected to actually occur would not make the remedy more protective, especially if the materials to be contained are already inert (as is the case with source materials at the Site).

NL appreciates that in recent communications EPA stated that such leaching issues and any associated changes to the conclusion that liners are needed can be dealt with during the design phase of this project. However, NL submits that at the very least the FS should contain a discussion that this is an open issue, that lead may not leach from a properly constructed containment cell, and that decisions on the exact design will be made during the design phase.

The FS Remedial Alternatives Substantially and Unnecessarily Increase Detrimental Impacts on the Community

Remedial alternatives that involve the unnecessary excavation and off-Site disposal of substantial volumes of soil/sediment, without significant reduction of actual real-world risk, do more than just waste limited financial resources. Such alternatives will also have a profound detrimental impact on Old Bridge, its residents and businesses.

EPA's proposed remedy alternatives could involve 500,000 tons of impacted material being transported from the Site (disposal) and to the Site (replacement materials) through a small community such as Old Bridge. Up to 102,000 truck trips might be necessary (51,000 full loads and likely an equal amount of empty trucks arriving to pick up disposal materials or leaving the Site after dropping off clean replacement materials). Exhaust and noise pollution from so many truck trips, and idling trucks lined up in the vicinity of the Site would be significant. Moreover, so many truck trips will substantially increase the possibility not only of traffic congestion, but also of serious traffic accidents. A project of this magnitude will have a profound negative impact on area businesses.

Beyond these actual impacts to the community, the substantial dredging proposed in the FS and the removal of essentially the entire Margaret's Creek upland sector would create tremendous (and unnecessary) environmental impact in the Raritan Bay and the upland area – far greater impact than the presence of the slag currently presents. Furthermore, implementation of any of the FS alternatives would result in a massive, long-term construction project that will effectively turn Old Bridge's beach and waterfront in the vicinity of the Site into a construction zone. EPA's Alternative 2 would require at least four years of field work to implement, compared to just several months for the first phase of the primary source removal alternative presented above. The long-term disturbance to the area that would result from implementing the FS remedies would contravene the community's desire to have the beach and seawall area reopened to the public as soon as possible.



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These factors of impact to the community are required to be considered in EPA's evaluation of the proposed remedial alternatives as part of the FS analysis of "short-term effectiveness". 40 C.F.R. 300.430(e)(9)(iii)(E). Although the FS notes that its proposed remedial alternatives will require years to implement and will entail many truck trips through the community, the FS fails to give any significant weight to this factor in its evaluation of the alternatives. Far more emphasis is placed on remote, theoretical risks of negative impact on a small number of mollusks, birds, or muskrats than on the very real risks and detrimental impacts that would be caused by implementation of such extensive remedial activities.

Conclusion

NL respectfully requests that the NRRB make the following recommendations to EPA Region 2:

- Include a phased/primary CERCLA source removal remedy alternative like the alternative presented above;
- Target lead above the PRG as a mechanism to ensure that only CERCLA sources are being addressed;
- Adjust the arsenic PRG to account for the lead/arsenic ratio of the CERCLA source material, appropriate background concentrations, EPA/NJDEP ecological screening levels and to be consistent with PRGs at other EPA sites;
- Eliminate the "unified" PRG approach;
- Use an area weighted average remediation approach;
- Review NL's comments on the HHRA and Ecological Risk Assessments and amend the documents to correct any errors;
- Acknowledge that liners/leachate collection in the on-Site containment cell may not be necessary and will be decided during the design phase; and,
- Provide a robust evaluation of the short-term impacts of this project on Old Bridge Township and the environment.

Implementation of a \$97 million to \$229 million remedy at this Site is not necessary from either a human health or ecological perspective. Both categories of potential risk can be adequately addressed by a remedy that involves substantially less excavation, consolidates all excavated CERCLA source materials on-Site, and does not include liners and leachate collection systems that ultimately will not enhance the protectiveness of the remedy. Adjusting the target to a lead-only PRG will ensure that only CERCLA sources are addressed, and adjusting proposed PRGs for arsenic and lead to be consistent with Site background, accepted ecological screening levels, and PRGs used at other Sites will result in a tremendous reduction in the volume of soil/sediment targeted for remediation. The resulting remedial action would be far less costly and have far less negative impact on the community but would be fully protective of human health and ecological receptors and meet all CERCLA/NCP criteria. To spend an extra \$80 to \$200 million to achieve some minimal incremental protection against theoretical ecological risks to a small population of wildlife receptors is simply not supported. Thank you for your consideration of this information.

February 20, 2012

2007-1973-07

Ms. Tanya Mitchell
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007

RE: Raritan Bay Slag Superfund Site
Remedial Investigation Comments

Dear Ms. Mitchell:

Over the last few weeks, NL Industries, Inc. (NL) and Advanced GeoServices have reviewed the data collected and the conclusions drawn in the Remedial Investigation (RI) (December 22, 2011) for the Raritan Bay Slag Superfund Site (Site), the Biological Assessment/Ecological Risk Assessment (April 2010), and the Characterization Report for the Development of Stabilization Approaches (September 23, 2011) prepared by Schnabel. It was a monumental effort to complete the review of the more than 1000 pages of information in such a short period of time. We mobilized to do so as quickly as possible, including engaging a risk assessment consultant to help, because of the U. S. Environmental Protection Agency's (USEPA) announced intention to issue a Feasibility Study (FS) for the Site by mid to late February 2012 and to hold a public meeting on February 28, 2012. This letter summarizes critical concerns that NL has with the data presented and relied upon in the RI (including the Risk Assessments and the Biological Assessment) and Characterization Report. NL believes that these concerns fundamentally impact the understandings of Site conditions, the resultant risks and, as a consequence, decisions as to the appropriate remedial strategy for the Site.

As noted above, the USEPA expects to release a FS for the Site to the public shortly. That FS will evaluate various remedial alternatives for the Site and preliminarily identify USEPA's preferred alternative. From our review of the RI, it is clear that the remedial alternatives considered in the FS will be based upon the conclusions presented in the RI that lead, arsenic and other metals are leaching from the slag pots at the Site in significant amounts, causing contamination of the adjacent surface water, groundwater, soil and sediments, and creating unacceptable human health and ecological risks. However, as discussed below, there are serious issues with much of the data upon which the conclusions in the RI and associated Human Health and Ecological Risk Assessments are based. Those issues call into serious question the conclusions in the RI, and therefore the basis for the upcoming FS.

In short, NL believes that flaws with respect to the collection and analysis of certain data have led to an incorrect determination of what risks exist at the Site, what is causing those risks, and what is the appropriate remedy to address those risks. NL proposes to collect certain additional data to replace the faulty data and fill data gaps. The additional data will either (1) provide



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reliable data to support the conclusions drawn in the RI; or (2) demonstrate that the conclusions drawn in the RI are incorrect, and that the slag pots are not leaching to surface water, groundwater, sediments and soil. We anticipate that the result will be the latter – the additional samples will show that the slag pots are not leaching into either the surface water or the groundwater, and that the conclusions drawn in the RI and relied upon in the FS need to be reevaluated. But either way, having the additional data would be a tremendous benefit.

The additional sampling proposed by NL would be performed in accordance with best practices so as to avoid the problems that plague the reliability of the existing data. Given that the slag pots have been present at the Site for 40 years, it makes little sense to rush to conclusions based upon faulty data, especially when the situation can be rectified with minimal time, effort and expense. As you know, NL already planned to visit the Site soon to excavate test pits, and can conduct the additional surface water and groundwater sampling at the same time. NL can complete the sampling quickly, so as not to effect the USEPA's plans to announce a remedy for the Site by September.

NL believes that when all of the concerns described in this letter are taken into account, and the results of the additional sampling are obtained, the available data will support NL's proposed remedy for the Site. That remedy consists of source control (removal of the slag pots comprising the Seawall as well as adjacent sediments impacted by mechanical weathering of the Seawall, and on-Site containment of that material) followed by a period of monitoring to determine whether any additional remedial action is necessary. Such an approach presents the most efficient and economical solution to the environmental issues at the Site, and allows USEPA, NL and the local community to avoid additional time-intensive, disruptive and expensive work that likely ultimately will prove unnecessary. We believe that following implementation of NL's proposed source control remedy, subsequent sampling will show that there is no unacceptable human health or ecological risk at the Site warranting any further action.

The problems with the existing data, the impact of the faulty data on the conclusions in the RI and Risk Assessments, and the additional sampling that NL proposes to conduct, all are described in more detail below. We ask that this letter and the attachments be included in the Administrative Record for the Site.

Most of the RI Surface Water Sampling Data is Not Representative of Site Conditions

The surface water data from the pre-RI sampling event in September 2008 which identified elevated metals is based on dissolved lead samples that were collected incorrectly and should be rejected. This means there is no accurate and representative data which indicates the slag pots are leaching to surface water. Statements and conclusions based on this data found throughout the RI therefore are unsupported and inaccurate. The most representative data comes from the April 2011 sampling event (which was conducted using



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appropriate methodologies) which shows that lead is not present in the dissolved fraction and thus is not leaching from the slag pots.

One issue with the September 2008 data is that the “dissolved” metals samples appear to have been preserved with acid in the field, prior to filtering. This technique was contrary to best practices, and resulted in unreliable data. The New Jersey Department of Environmental Protection’s “Field Sampling Procedures Manual,” for example, makes clear that “[w]hen filtration is performed, it must be done immediately upon sample collection and prior to sample preservation. The sample may not be transferred to the laboratory for filtration and preservation nor may it be preserved prior to filtration.” (Aug. 2005, p. 140). As noted in the Manual, “[a]cidification of an unfiltered sample will dissolve some particulate matter, thereby raising the original metals content by releasing adsorbed metals into solution.” (p. 139). That is what happened in the case of the September 2008 samples. The acid in the sample collection containers dissolved the particulate and suspended matter (containing the non-dissolved lead) and made the lead appear to be dissolved. In other words, lead that was not dissolved under natural conditions became dissolved in the samples because of the collection techniques used. This means the dissolved lead concentrations identified in the RI for the critical areas close to the slag pots (Areas 1 and 8) are incorrectly biased high.

That the September 2008 surface water data was preserved in acid without field filtering is supported by several lines of evidence:

- A. The dissolved metals data from the September 2008 sampling event provided in Attachment A shows the dissolved and total lead concentrations are essentially the same. However, the dissolved concentration should be less because the suspended fraction has been removed. This anomaly was noted in the RI report in Section 4.3.2.1, but was incorrectly attributed to non-homogeneity in the samples without consideration of either (1) the faulty sampling techniques, or (2) the combination of “activity-based” samples with non-biased sample results (which is discussed in more detail below).
- B. The description of the field collection within the January 2009, Weston Solutions, Inc. “Summary Letter Report, Raritan Bay Slag, Old Bridge and Sayreville, New Jersey” (provided in Attachment B) does not describe field filtering. Subsequent sampling summary reports do specifically call out the field filtering of surface water analyzed for dissolved lead, confirming that the absence of a reference to field filtering in the September 2008 sampling event means that it was not performed. Moreover, results from those subsequent sampling events show significantly lower concentrations of dissolved lead and other metals relative to totals.



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- C. Likewise, the field notes provided as Attachment C also do not describe field filtering of the surface water samples collected during the September 2008 sampling event, again confirming that field filtering was not performed.

A second issue with the surface water sampling data arises from the fact that certain samples were intentionally agitated to place sediment into suspension (called "activity-based" samples) prior to placement into sample containers, thus increasing the lead content. The problem is that this difference in sampling techniques was not taken into consideration in evaluating the data in the RI and the Risk Assessments. When this data was used in the RI and the Risk Assessments, no reference or note was added regarding the special nature of the samples and the resulting intentionally high bias. Instead, it appears that the activity-based samples were considered alongside the other samples as if they were collected using the same techniques and represented the same Site conditions. In other words, it appears that the fact that certain samples were activity-based was inadvertently lost when the data was incorporated into the RI analysis.

These deficiencies are significant for the following reasons:

- First, all of the data from the RI surface water sampling for total and dissolved lead collected in this area in Fall 2010 was rejected during data validation. Samples taken in April 2009 were taken from areas where slag is not present. So, with the September 2008 dissolved lead data being flawed as described above, this means no accurate and representative surface water data were used in the RI to assess the impact of slag pots in the Seawall and Western Jetty areas of concern. In other words, the conclusions set forth in the RI are completely without supporting data.
- Second, not only are the RI conclusions not supported by data, those conclusions (as well as those in the Human Health and Ecological Risk Assessments) likely are affirmatively wrong. The conclusion that the slag pots are leaching into the surrounding ocean at high concentrations is based upon the September 2008 data showing high lead levels in the surface water. However, as discussed above, all of the samples are biased high, providing an inaccurate and misleading picture of how much lead is dissolved in the surface water under natural conditions.
- Third, this misleading picture of actual Site conditions based upon the biased-high data appears to be driving the USEPA's conclusions in the RI and Risk Assessments as to the risks and pathways of concern. Furthermore, although the FS has not yet been issued, informal conversations with USEPA personnel suggest that the USEPA is forming remedial action preferences based upon its perceptions as to the leachability of the lead in the slag pots. An incorrect perception as to the leaching potential of the slag pots could lead the USEPA



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toward a preference for remedial actions that are much more time consuming, expensive and disruptive than necessary to protect public health and the environment.

Samples collected in April 2011 from Area 2 appear to have been collected properly and without agitation. However, those samples, although reported in the RI, were collected too late to be included in the risk assessment or other data evaluation in the RI. Those sample results show much lower total lead than the “activity-based” samples (3.8 ug/L as compared to 1450 ug/L), and the dissolved lead concentrations are all below the detection limit in the April 2011 data set. This data set, albeit very small (five samples with one field duplicate) for such a critical issue, is the only valid data set available to assess the actual impact of the slag pots on the surface water, but it was not used at all in the data analysis in the RI. That the dissolved lead concentrations in surface water near the slag pots is low makes sense. Our experience at other sites has shown that the slag pots are inert, and do not leach unless exposed to acidic or basic environments. The pH of the ocean water near the Site was measured at 7.02 – essentially perfectly neutral. Under such conditions, leaching of lead from the slag pots would not occur.

Additional data should be collected to understand the actual surface water conditions in the areas in question. NL proposes to collect 10 new surface water samples from near the Seawall. The samples will be collected in accordance with best practices (including field filtering prior to preservation) to avoid the problem that rendered the September 2008 data faulty. NL can collect the samples at the same time that NL accesses the Site for the test pit study. We believe additional surface water data will demonstrate the slag pots are inert and are not leaching into the surrounding areas, which will significantly alter the evaluation of the risks posed by the slag pots and what remedies may be necessary to protect human health and the environment. But regardless of what the additional sampling shows, having reliable data to support the conclusions that will be drawn regarding the risks and remedies at the Site is essential.

Groundwater Sampling Data Also is Not Representative of Site Conditions

Turbidity may be creating false positives for lead in groundwater, thus mischaracterizing groundwater conditions at the Site. Although lead in groundwater does not drive Site risks, it directly and fundamentally impacts the Conceptual Site Model which will be the basis of multi-million dollar decisions on the need for a bottom liner and/or treatment to reduce Site risks. Our previous experience on over ten similar sites is that lead in the form of slag and slag pots is inert and does not leach to groundwater unless acidic or basic conditions are present. We believe additional sampling of groundwater should be conducted and this sampling should include both total and dissolved lead and other metals to understand whether the extreme expense associated with treatment or a bottom liner would actually provide any risk reduction at all at the Site.



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NL previously brought this turbidity issue to the attention of the USEPA, and USEPA acknowledged the possibility of issues with the reliability of the data. We have experienced very similar turbidity related mischaracterizations and false positive readings in groundwater at the Jack's Creek and Tonolli Superfund Sites in Pennsylvania, the Gould Superfund Site in Portland, Oregon and at smelter sites in Tennessee and Indiana. On at least three of these sites, USEPA or the state oversight agency believed a lead plume existed, yet the high lead concentrations in the initial site samples were later proven to be related to high turbidity, poor well installation and/or development techniques, and/or poor sampling techniques. We believe this is the case at the RBS Site as well. The following lines of evidence suggest the total lead concentrations measured in groundwater are not due to the presence of a dissolved phase lead plume at the Site that would be indicative of the slag pots leaching:

- Well MW-10D is located immediately adjacent to the Seawall, as shown on Attachment D, in an area known to have high concentrations of lead in the pots and the underlying soils. Well MW-10D had lead concentrations of 18.1 ug/l and 79.5 ug/l. It is our experience that despite all the precautions taken during drilling, minor levels of cross contamination are almost always driven down during well installation activities. This likely is from soil/sediment on the auger's flights and may also be from materials on the spoons driven to collect samples. The extremely low concentrations of lead measured in groundwater could be created by just 1 part per million lead in soil from the overlying soils being driven downward during well installations and becoming entrained in a turbid groundwater sample. This would cause a spike of the groundwater which exceeds the standards being used at the Site.
- Turbidity readings during development of MW-10D were recorded as ER2 or ER3 on the Well Development Record from October 28, 2010 provided as Attachment E. We believe this code used by the field technician indicates there was an error reading the turbidity because it exceeded the instrument range. When the well was sampled the first time on January 5, 2011, the turbidity could not be reduced below 50 NTU and when the well was resampled on April 6, 2011, the turbidity could not be reduced below >999 NTUs as shown on Attachment F. These well development and sampling records indicate the water had high turbidity, and the reported lead results should not be considered representative of the groundwater conditions. It is commonly our experience that the wells which are most difficult to develop are the wells which have the highest lead concentrations, consistent with being false positive results.



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- Well MW-10S is located adjacent to MW-10D, immediately adjacent to the Seawall. Well MW-10S had lead concentrations of 107 ug/l and 36.6 ug/l. The RI documents indicated this area has high lead concentrations in soil/sediment and the lead in sediments underlying the seawall could have easily be driven down and mobilized during well installation activities. We note that this well is screened from 7 to 17 feet below grade and several feet of impacted sediment is likely found beneath the seawall itself. This means the top of the well screen could easily be in or just below the impacted sediment in the seawall impacted area. Despite this, a bentonite filter pack seal was not placed at the top of the well screen to separate the potentially impacted sediments and the groundwater. This means development and purging activities would be prone to actually pull the overlying lead impacted soils into the well. The first sampling event had a concentration of 107 ug/l lead and the second sampling event had a concentration of 36.6 ug/l lead. We believe the significant downward trend in the readings may be attributed to the additional purging activities which eliminated some of the potential to cross contamination impacts from drilling activities and helped to reduce the turbidity in the well.
- We also note well MW-10S had high salinity due to the ocean influence. This means groundwater in this zone would be considered a New Jersey Class III aquifer, rather than a Class II aquifer, because the water could not be used as drinking water without significant treatment. Thus, the use of drinking water action levels at this well as the screening criteria in the RI was not appropriate.
- Well MW-12S had a measured lead concentration of 20.4 ug/l which is slightly above the USEPA's federal Action Level for lead in drinking water. This well has impacted material above it which could have easily been driven down during the well installation activities and mobilized with turbidity during sampling. We note that the well is screened from 6 to 16 feet and several feet of impacted soil and slag could be found in the area. This means the top of the well screen could easily be in or just below the materials impacted with lead. Despite this, a bentonite filter pack seal was not placed at the top of the well screen to separate the potentially impacted soil and slag and the groundwater below.
- The well sampling records indicate well MW-12S also has a high salinity due to the ocean influence and the water in this area would not be considered a New Jersey Class II aquifer, so the use of the drinking water action levels as screening criteria for this area was not appropriate.



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Lastly, Well MW-11S, identified on Attachment D, is the background well for the Site. It exceeded the Site screening level of 5 ug/l for lead with a reported lead concentration of 7.3 ug/l. Unfortunately, it was only sampled once so it is difficult to get an understanding of the natural variability of the groundwater background. However, using a factor of two to account for the natural background variability would result in a lead level of about 15 ug/l being used for screening. Using this concentration as a Site background screening level, which also corresponds to the USEPA federal Action Level for lead in drinking water (i.e., the lowest concentration which can reasonably be expected from drinking water sources at the tap), only 3 wells are found to exceed this 15 ug/l Action Level. The wells with lead concentrations above this USEPA Action Level are MW-10S (107 ug/l, and 36.6 ug/l), MW-10D (18.1 ug/l and 79.5 ug/l), and MW-12S (20.4 ug/l). As described previously, these wells had either construction or sampling technique deficiencies that caused the lead concentrations above the standard and the results are not likely representative of aquifer conditions. Also, the incorrect standard (drinking water) was applied in the RI in error as the groundwater in this area cannot be used as drinking water without significant treatment to remove its natural salinity.

In short, we believe that the existing data are not representative of groundwater conditions at the Site and do not support the need for a bottom liner or the need to treat the lead, which appears to be inert, to reduce leachability. NL believes it is critical to resample these 3 wells and the background well for total and dissolved lead to eliminate the turbidity effects and accurately characterize site groundwater before any conclusion regarding potential impacts of metals to the groundwater are reached. NL proposes to take additional samples for total and dissolved metals from each of the four above-mentioned wells. We will use best sampling practices (including low-flow purging and sampling methods) to avoid the turbidity effects that likely impacted the previous samples. We believe that the results of the additional groundwater sampling will confirm that lead levels in the groundwater near the Seawall are consistent with background levels, and that lead from the slag pots is not leaching into the groundwater. Groundwater at the Site is only very weakly acidic (pH of between 5 and 6), which is not enough to cause leaching of lead from the slag pots.

Because the groundwater data may be used as a basis for evaluation in the FS as to the need for a bottom liner for containment cells or treatment of material to be deposited in the cells – two requirements that would significantly increase remedial costs, every reasonable effort should be made to ensure that the data used to support the ultimate conclusion is reliable. Again, even if the additional sampling ends up confirming rather than refuting the conclusion in the RI that lead is leaching into the groundwater, having reliable data to support that conclusion will have made the additional sampling worthwhile. Given the minimal time, effort and expense involved in obtaining additional groundwater data, it makes little sense to proceed without performing the additional sampling.



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Potential Crushing of Slag Pots in Order to Treat the Slag is Not Warranted

The existing slag pots are massive, stable, erosion resistant, high strength, very low permeability materials. As described above, there is no accurate and representative data which indicates this material is leaching in place to groundwater or leaching into surface water. Further, the only demonstrated mechanism of slag movement is mechanical weathering, which has impacted nearby sediments. Any remedy for the Site should try to efficiently and effectively address mechanical weathering along with direct contact with the slag pots as the realistic exposure pathways of concern. Crushing the slag pots would not only be unnecessarily labor-intensive and expensive, but would actually be counterproductive to the goals of stability and protection against leaching.

Schnabel Engineering prepared the Characterization Report for the Development of Stabilization Approaches dated September 23, 2011. For their analysis they took samples of the slag pots. The pots, which have been exposed to forces of the ocean for over 40 years, had such high strength Schnabel needed to drill them with a diamond-bit core. The end pieces of the cores were crushed separately using a compaction hammer. Some of the slag was also sent off-site to a steel processing facility in the Sparrows Point Mill Complex operated by Phoenix Services, LLC in Baltimore, Maryland. Pictures which show the industrial strength equipment required at the steel processing facility to supply the extraordinary pressure to crush the slag are provided as Attachment G.

Leaching tests were also part of the analysis conducted by Schnabel and they summarize the leaching results as follows:

Most interesting of all, the SPLP-Pb (lead) concentrations [leaching test] are non-detectable despite total metal concentrations on the order of 43,000 to 52,000 mg/kg (4.3% to 5.2 wt%). Very similar leaching behavior was observed under DIW [the Deionized Water Leach Test] extraction conditions (Table 18). [p.22]

The extremely low metals leaching behavior of the crushed slag under SPLP and DIW extraction conditions stresses the importance of the influence of mineralogy, morphology, matrix effects and system pH on metals mobility.

Schnabel suggests that the best way to deal with the existing exceedingly high strength, exceedingly low permeability slag pots, which the Schnabel testing shows are not leaching under conditions representative of current and future exposure conditions, is to crush the slag material to <3/8", and mix in as much as 16.5% phosphate based chemicals, cement, water and bentonite. We note several concerns with this approach:



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- Crushing the slag will increase the surface area of the slag several thousand times, which would promote any potential leaching that might occur. On the whole, even if this material is mixed with cement and bentonite, this increase in surface area will make the new monolith more prone to leaching than the existing pots.
- As the Schnabel report indicates, crushing and coring the slag are energy intensive processes requiring very specialized industrial processing equipment which will significantly increase the time to perform the remedy and will create significant dust and noise. Because of the high concentrations of metals in the dust, significant amounts of water would be required to address the dust and then need to be captured, controlled and treated. Further, controlling the crushing noise in the residential and recreational areas surrounding the Site where these operations will be conducted will be extremely difficult. Crushing to 3/8" will require significant infrastructure to be implemented.
- Use of additional chemicals in the residential and recreational areas surrounding the Site, needed to stabilize the crushed slag, is not recommended and will delay the remediation time.
- Lead is soluble at elevated pHs which may be created by a cementitious treatment system designed to meet TCLP standards. See USEPA. 1991. Selection of Control Technologies for Remediation of Lead Battery Recycling Sites. EPA/540/2-91/014. July (pp. 52-53); Conner, J.R. 1990. Chemical Fixation and Solidification of Hazardous Wastes. Van Nostrand Reinhold. New York, NY. (p. 35). (Advanced GeoServices has additional references supporting this fact, available on request.)

Schnabel mistakenly states there is a need for materials at the Site to pass the TCLP for lead due to land disposal restrictions (p. 30). This is not accurate. It is a matter of public record that materials with elevated lead levels which exceeded TCLP were consolidated and capped at the Jack's Creek Superfund Site, Marjol Battery RCRA Site, and many other Sites, without bottom liners. The referenced Sites had consolidation and capping type remedies, and USEPA determined treatment of all the material to TCLP standards did not add any significant degree of protectiveness to the remedy, the materials could be reliably contained, and there was not a significant reduction in toxicity, mobility, or volume associated with treatment. The same is true at the RBS Site.



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We note that the TCLP standard was developed to mimic the specific conditions which might be present in a solid waste landfill. To replicate these organic waste degradation conditions, the TCLP test uses an organic acid to simulate the acid which might be created by exposure of water to the degrading organic municipal waste materials. Conditions identified at the RBS Site, and conditions which are expected at the RBS Site following a capping, on-Site containment, or treatment remedy, would be considerably different than a municipal waste landfill. There will be no municipal waste to create acidic conditions, and groundwater at the Site has been measured to have pH between 5 and 6 – much less acidic than the acetic acid used in the TCLP test, which had a pH of just 2.8. Designing a remedy with a bottom liner and/or treatment to meet a condition which is never expected to actually occur would not make the remedy more protective, especially if the lead materials to be contained are already inert. All remedy efforts should be focused on reducing the actual risks identified at the Site as quickly and as safely as possible.

Summary of Leaching Issues

The issues discussed in the preceding three sections call into question one of the key aspects of the Conceptual Site Model (Section 5.4) presented by USEPA in the RI, which is that the leaching of metals is a primary pathway for the release of metals into the environment. When the data not subject to the collection and analysis issues discussed above is considered, that data shows that metals are not leaching from the slag pots. Thus, several statements in the first paragraph of Section 5.4.3.1, Overview of Primary Migration Mechanisms, are simply not supported by the data in the RI. Only the erosion (by mechanical weathering) of particulates from the source materials is a primary pathway for contaminant migration, not leaching. Controlling particulate erosion and preventing direct contact with the source materials addresses the primary risks at the site.

Having an accurate conceptual model of conditions at the Site, based on representative surface water and groundwater information is essential so an effective and appropriate risk reduction approach may be developed and implemented. To better understand these issues, NL has proposed in this letter to complete additional investigations to understand the actual volume of slag present at the Site, the actual impacts of metals, including lead, on groundwater, and the actual surface water conditions in the area surrounding the seawall and Western Jetty. NL's Work Plan for these activities will be provided under separate cover.

Risk Assessments

Both the Human Health Risk Assessment (Appendix T of the RI) and the Ecological Risk Assessments (Appendix U of the RI and the 2010 Biological Assessment) for the Site overstate actual risks, for a variety of reasons described below. Neither of them can serve as an adequate basis for determining remediation needs.



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In addition to our concerns discussed above regarding the reliability of surface water and groundwater data, and the recommendation of crushing slag, we also have concerns regarding some of the analyses and conclusions contained within the Human Health and Ecological Risk Assessments. Those concerns are discussed below.

Background Conditions and Screening Levels

There is some inconsistency among the Risk Assessments as to the Site-specific background levels of lead and arsenic. More concerning, however, is the USEPA's lack of recognition that the ecological screening level for arsenic and lead used in the RI is many times lower than either of the Site-specific arsenic and lead "background" levels identified in the Risk Assessments. Although the calculations performed followed USEPA guidance except as noted below, in situations such as this where the ecological screening level is far below actual Site-specific background levels, it is the Site-specific background levels that should be used to set the ultimate cleanup levels for the Site. There is virtually no discussion in the RI of the fact that use of the screening levels that are well below Site-specific background in the Risk Assessments dramatically overestimates the impact of the slag on Site conditions, which causes NL concern that (1) the public might be misled as to the risks actually associated with the presence of the slag at the Site; and (2) the focus on such screening levels for arsenic and lead might inadvertently be carried over into the FS and therefore inappropriately affect remedial decisions regarding the nature and scope of the proposed remedy.

- A. The USEPA collected Site-specific background soil and sediment samples east of the Site, in Area 10, and affirmatively stated in the RI that the samples are representative of background conditions. Section 4.1.3 of the RI states: *"These samples were considered representative of background conditions because they were far removed from the placement of slag, they were unlikely to have been impacted by contaminants associated with the slag based on an evaluation of tidal and storm induced currents and because they don't appear to be influenced by localized sources. As a result, the samples are considered to be representative of general conditions within Raritan Bay and the Margaret's Creek wetlands."*

According to Appendix T of the RI, which is the Human Health Risk Assessment, the Site-specific background concentration for arsenic in wetland sediment is 46 mg/kg and the corresponding background concentration for lead is 193 mg/kg (RI Appendix T, p.6-15). However, according to Appendix U, the Screening Level Ecological Risk Assessment, the sediment background concentration for arsenic is 38.7 mg/kg and the sediment background concentration of lead is 181.5 mg/kg (RI Appendix U, p 5-8). In short, there is an inconsistency between the Risk Assessments as to the background levels of lead and arsenic in sediment.



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Regardless of which of those Site-specific “background” levels is used, those levels exceed the regional soil background levels of 19 mg/kg for arsenic and 47 mg/kg for lead, implying there are local anthropogenic sources unrelated to RBS slag. Further, as shown on Figure 1, which identifies the area where the background samples were taken, even a simple average concentration of the Area 10 background sediments results in a concentration of 27.6 mg/kg for arsenic and 130 mg/kg for lead, both significantly above the screening levels used in the Risk Assessments.

- B. In the RI (page 4-3 to 4-4), USEPA states that *“background conditions may be described as naturally occurring or anthropogenic. Anthropogenic background considers the presence of natural and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA release in question).....In general, CERCLA does not clean up to concentrations below natural or anthropogenic background levels.”* (Emphasis added). USEPA goes on to state in the RI that *“site specific background results were not used for comparison purposes in this RI, but will be discussed in the risk characterization and will be considered during the the development of preliminary remediation goals at the site and in the evaluation of remedial action alternatives in the feasibility study.”* (page 4-4 of the RI)

After (1) identifying Site-specific background levels based upon sampling of a nearby area not impacted by slag; and (2) acknowledging that CERCLA does not require clean-up to levels below background, USEPA selected screening levels for arsenic and lead in the Screening Level Ecological Risk Assessment that are far below the Site-specific background based on published, regional data. USEPA used an unrepresentative screening level of just 8.2 mg/kg for arsenic, in contrast to an arsenic background level of 46 mg/kg identified in the Human Health Risk Assessment and an arsenic background level of 38.7 mg/kg identified in the Screening Level Ecological Risk Assessment.¹ Similarly for lead, the screening level used is 47 mg/kg, much lower than either of the background concentrations given for lead of 193 mg/kg or 181.5 mg/kg.

This methodology of performing Site-specific evaluations of ecological and human health risks using screening levels far below the background concentration (five time lower for arsenic, in fact) results in Risk Assessments that do not accurately reflect any risks associated with the slag deposited at the Site. For example, of the 211 wetland sediment samples in Area 9, only 3 samples

¹ Although USEPA's Ecological Risk Assessment analysis in Appendix U seems to be based upon a regional arsenic screening level of 8.2 mg/kg, USEPA references a screening level of 13.6 mg/kg for arsenic in sediment in the main body of the RI, which adds to the confusion and inconsistency regarding USEPA's risk assessment analysis.



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exceeded the Site-specific background concentration of 46 mg/kg for arsenic presented in the Human Health Risk assessment. However, 128 samples exceeded the unrepresentative regional screening level of 8.2 mg/kg used in the Screening Level Ecological Risk Assessment.

We understand that it is appropriate for USEPA to consider in the Risk Assessments risks based upon exceedance of screening criteria based on published values. However, as acknowledged in USEPA's above-quoted statements from the RI, the discussion in the Risk Assessments should acknowledge the impact on the risk that is attributable to natural or anthropogenic background levels of contaminants of concern at the Site. We are concerned that aside from a couple of brief, vague references to the Site-specific background levels in the Risk Assessments appended to the RI, there is virtually no acknowledgement in the RI or the Risk Assessments of the tremendous impact that the use of screening levels that are unrepresentative of actual Site-specific background levels has on the risk assessment analysis, the RI conclusions and ultimately, cleanup levels selected for the Site. We are concerned with the potential that this situation has to mislead the public. Moreover, based upon my recent telephone conversation with you in which you informally mentioned ecological risk posed by arsenic being a driver for the remedy and the potential need to excavate large quantities of sediment or soil, we are concerned that use of the generic screening levels may have an inappropriate influence on remedy selection.

- C. USEPA never evaluated other potential sources of arsenic and lead in the area. A discussion of potential sources of arsenic and lead are provided in Appendix I.

Comments on the Human Health Risk Assessment

In the Human Health Risk Assessment, USEPA concluded that there are unacceptable human health risks for the following scenarios:

- A. Adult and child anglers consuming fish or hard clams (risks from non-lead constituents);
- B. Residents using groundwater as drinking water (risks from non-lead constituents);
- C. Female construction/utility workers of child-bearing age (lead risk only); and
- D. Child recreational users in Area 2 (lead risk only).



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However, as discussed below, all of these risks are overstated and/or are based on faulty data, thus these results should not be used to justify the need for remediation.

- A. For adult anglers consuming fish or hard clams, USEPA reported a cancer risk of 2×10^{-4} , and for a child consuming fish or hard clams, USEPA reported a reasonable maximum exposure (RME) hazard index (HI) of 2. For both, all of the risk is due to ingestion of arsenic, and the risks are based on the assumption that all of the arsenic is inorganic arsenic. However, the major form of arsenic in marine animals is in the form of arsenobetaine, which is an inert compound that is non-toxic under conditions of human consumption (ATSDR, 2007a; EFSA, 2009). Although arsenic speciation would be needed to confirm this, it is highly likely that arsenic in seafood at the Site is largely organic and does not contribute to an unacceptable risk for fish or clam consumption for either adults or children. Inorganic arsenic in fish is typically only 1% to 10% of the total arsenic (Schoof and Yager, 2007). Assuming that to be true for fish or clams in the vicinity of the Site, risks estimated by USEPA would be reduced by a factor of 10 or more, such that they would fall in the acceptable risk range.
- B. The conclusions drawn for adult and child residents using groundwater as drinking water are not valid because the only available groundwater data is flawed as described above. Furthermore, the groundwater at the Site is not actually used as drinking water because of high salinity. With respect to the actual risk calculations, USEPA reported an RME HI of 15 for the child. Nearly all of the reported risk was from ingestion of groundwater, and the risk drivers were iron and cobalt (combined HI of 12.1). None of the other constituents alone had an HI greater than 1. USEPA noted that iron and cobalt in groundwater are likely due to naturally occurring conditions. Specifically, USEPA noted that although "iron is a major component of the slag...several lines of evidence indicate the elevated iron concentrations in groundwater are also from existing geochemical conditions in the area", and "high levels of iron in groundwater are attributable to the anaerobic conditions in that portion of the aquifer likely a result of the organic rich water from the wetland." USEPA also noted that "cobalt is a naturally occurring metal and is not a major component of the slag. Cobalt may be released from soil under acidic conditions in groundwater in Areas 1, 4, and the upland area of Area 9." Given that the iron and cobalt levels, which are the primary risk drivers for Site groundwater, appear to be associated with background conditions at the Site, the groundwater risks should not be used to justify the need for remediation.



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- C. For the female construction/utility worker of childbearing age in all upland areas, USEPA reported a risk of fetal blood lead exceeding $10 \mu\text{g/dL}$ of 11.14% from incidental ingestion of soil. This risk is overestimated due to the use of an inappropriate soil ingestion rate. The risk assessment used a soil ingestion rate of 330 mg/day for the construction worker in the adult lead model. However, an ingestion rate of 330 mg/day is not appropriate for a construction worker in a lead risk assessment, and the guidance document cited by USEPA does not apply to lead risk assessment. It is important to recognize that the exposure inputs used in a lead risk assessment should be central tendency estimates, not upper-bound estimates, because the blood lead model predicts a geometric mean (GM) blood lead level, and the geometric standard deviation (GSD) is then used to calculate the upper bound estimate (95th percentile) blood lead level. USEPA (2002, page 5-9)² notes that the value of 330 mg/day is based on the 95th percentile value for adult soil intake rates reported in a soil ingestion mass-balance study (Stanek, 1997), thus this is an upper-bound value. USEPA's Adult Lead Model Guidance notes that the soil ingestion rate used in the model should be a central tendency (average) value and recommends a default value of 50 mg/day as a "plausible estimate of the central tendency for daily soil intake from all occupational sources resulting from non-contact intensive activities" (USEPA, 2003). Since a construction worker has more intensive contact with soil, an appropriate central tendency soil ingestion rate would be twice the default value, or 100 mg/day. If this value is used, then the lead risk (*i.e.*, the probability of a fetal blood lead greater than $10 \mu\text{g/dL}$) is only 0.4%, and meets USEPA's criterion of being below 5%.
- D. For the child recreational user in Area 2, based on incidental soil ingestion, USEPA reported lead risks of 9.68% based on total lead, and 42.16% based on lead in the fine fraction. Although USEPA said these risks are for a recreator, they are actually for a residential scenario. This is because the IEUBK model used by USEPA assumes that the child is exposed 365 days/year and USEPA's risk scenario made no departures from the default parameter values used in the IEUBK Model to model residential risks. In contrast, when USEPA estimated risks for the current adult and adolescent recreational users in all areas (Table 4-3), USEPA assumed exposures of 100 days/year. Likewise, USEPA assumed exposures of 100 days/year for a young child recreational user in the cancer and non-cancer risk estimates (*e.g.* for arsenic). As a child under the age of 6 years is likely to visit the Site with an adult, the exposure frequency for the child should also be 100 days/year when assessing lead risk, consistent with the approach for adult recreational users and the approach for all recreation users in the evaluation

² USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites OSWER 9355.4-24, December 2002.



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of cancer and non-cancer risk. Because exposure frequency cannot be adjusted directly in the IEUBK model, one must use a time-weighted soil concentration. If we use the approach consistent with that used by USEPA for adolescents and adults, then we would use 100 days/year at the Site and 265 days/year at home. This gives a weighted soil concentration of 260 mg/kg $((100/365) \times 685 + (265/365) \times 100 = 260 \text{ mg/kg})$ (assuming a background concentration of lead in the home environment of 100 mg/kg).

In addition, there appears to be an error in USEPA's bioavailability calculations. EPA used an absolute bioavailability of 42% in the IEUBK model, however, the correct value should be 37%. USEPA used Site specific data for the bioavailability of lead, and used the results from only 5 of 39 samples (*i.e.*, those with soil lead >1000 mg/kg); four of the five samples were from Area 9, and one sample was from Area 2. The average IVBA result from those five samples was 84%. USEPA indicated that they converted the in vitro bioavailability (IVBA) to the relative bioavailability (RBA) using the correlation equation shown on page 3-3 of the Human Health Risk Assessment Appendix D.³ However, that conversion would have yielded an RBA of 74%, rather than the RBA of 84% that USEPA used. With an RBA of 74%, an absolute bioavailability of 37% (half the RBA) should have been used in the IEUBK model.

USEPA also applied the bioavailability adjustment to both soil and house dust in the model, but this value should only have been applied to soil. The source of lead in the home environment differs from the source of lead at the Site. In the absence of specific information about the lead source in the home environment, the model default bioavailability value should be used to assess exposures that occur in the home environment. We also assumed that the house dust lead concentration was the same as the home soil lead concentration (100 mg/kg). Taking into account all of the above-discussed modifications results in a lead risk⁴ for a child recreational user of just 0.7%, which indicates that there is no unacceptable lead risk from this scenario.

When all of these factors with respect to each of the above-discussed scenarios are considered, it becomes clear that there are no unacceptable human health risks at the Site.

³ The correlation equation is $RBA = 0.878 \times IVBA - 0.028$, where IVBA is given in percent.

⁴ All calculations done for the age range 0-72 months to be consistent with the range used by USEPA in the risk assessment.

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Comments on the Ecological Risk Assessments

Risks to the environment are addressed in the 2009 Ecological Risk Assessment (ERA), and in the 2011 Screening Level Ecological Risk Assessment (SLERA) attached as Appendix U to the RI. The ERA evaluated Area 1 of the Site, while the SLERA evaluated Areas 8 and 9. Both documents examined risks associated with contaminants in soil or sediment, and in surface water.

Both the ERA and SLERA over-state risks associated with contaminants in surface water. Both rely on maximum surface water concentrations from a data set collected between 2008 and the present. As described above, dissolved surface water analyses of samples collected during the September 2008 sampling event are not representative and are biased high due to lack of field filtering before preservation, thus dissolving the particulate matter. Further, the total metals (as well as the dissolved) were also not representative and biased high in a selection of samples referred to as "activity-based", where sediment was actively stirred up immediately prior to sample collection to mimic disturbances that could occur by beach users or swimmers. Risk conclusions in the ERA (Area 1) were based on sample RBS-SW10d, which was one of the activity-based samples. These results, representing the impact of a short-term disturbance to the water column, are not representative of chronic risks to ecological receptors. Similarly, risk conclusions from the SLERA (Areas 8 and 9) are also based on samples from the September 2008 field collection (RBS-SW16 for Area 8 and RBS-SW19 for Area 9). These samples, while not activity-based, yielded substantially higher results than subsequent surface water samples taken from the same areas during later sampling events. For example, while sample RBS-SW-19 had a total lead concentration of 298 µg/l, the highest concentration from any sample taken from other sampling events in this area was 17 µg/l (Sample A9-89 taken in June, 2011), more than a factor of 10 lower. As a result, surface water risks presented in both the ERA and SLERA are not representative of actual conditions.

Based upon a recent telephone conversation with you, our understanding is that USEPA views the ecological risk associated with arsenic as the primary driver of the extent of the necessary remediation at the Site. Based upon our review of the ERA and SLERA, we have difficulty understanding that position. The data we have reviewed does not seem to support any remedial action beyond the source control measures that NL has already proposed to perform – removal of the Seawall and some adjacent sediment for on-Site containment. Moreover, nothing in Ecological Risk Assessments suggests a need for remediation to address arsenic independent of lead. Both the SLERA and the ERA indicate that lead, rather than arsenic, should be the primary contaminant of concern with respect to evaluation of ecological risks. Furthermore, the RI data confirm that to the extent any significant arsenic contamination exists that could be attributed to NL, it exists together with lead contamination and therefore would be addressed by a lead-driven remedy.



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The SLERA also estimates risks due to contaminants in soil and sediment in Area 9 and sediment in Area 8 based on maximum concentrations and comparison with generic screening values. Although this is a standard approach for a screening level risk assessment, comparison to maximum concentrations alone does not give a picture of the physical extent of potential risks, and generic screening values are not equivalent to cleanup levels. The SLERA is useful only in that it identifies lead as the most important contaminant of concern for ecological risks. (The hazard quotient (HQ) for lead is generally higher than for arsenic, often by a large margin. For example the SLERA reports an HQ for lead in Area 9 soil of 927, and an HQ for arsenic in Area 9 soil of 9.9.) As discussed above, remedial decisions should not be based on screening levels that are unrepresentative of actual Site conditions when they are five times lower than Site-specific background levels.

The ERA for Area 1 moves beyond the screening level approach, and estimates hazard quotients for a number of ecological receptors including sediment-dwelling organisms and shore birds. In all scenarios, lead is the risk driver, and the hazard quotient for lead is often a factor of 10 or more higher than the hazard quotient for arsenic (*e.g.* HQ of 23.4 for lead and 1.7 for arsenic, for sediment dwelling organisms based on the 95% UCL concentrations). In fact, arsenic hazard quotients are generally in the range of 1 to 2, and would not necessarily of themselves drive a need for remediation. Like the SLERA, the ERA considers the bioavailability of metals in soil and sediment to be 100%, likely an over-estimate. The ERA also assumes that ecological receptors forage only at the Site, a further conservatism for many receptors (*e.g.* shore birds) that results in an over-statement of the risks.

Arsenic and lead are well correlated at the Site where lead concentrations are high, suggesting a common source in the slag and other waste materials. However, arsenic concentrations are sometimes high in the absence of elevated lead levels (*e.g.* soil sample A9-103C in Area 9 with lead at 15.6 mg/kg and arsenic at 22 mg/kg; or sediment sample C19 in Area 8 with lead at 16.1 mg/kg and arsenic at 38.4 mg/kg). In such instances, the arsenic likely results from an unrelated source or represents the high concentration end of the background range. Considering both the low hazard quotient for arsenic in the ERA and the good correlation of arsenic and lead, any needed remediation for ecological risks should be based on lead concentrations. However, as the ecological risks are overstated because of use of conservative screening levels for soils and sediments, the use of additional conservative assumptions about bioavailability and foraging range, as well as the use of biased surface water analyses, it would be premature to base remediation of soils and sediments on these estimates of ecological risks. Further, the impacted area is small relative to available ecological habitat. As a result, it makes most sense to achieve source control first, and follow that with further monitoring and sampling focused on determining whether an ecological risk exists following removal of the primary waste.



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Additional Comments

Some additional comments regarding Site data and other issues are contained in Attachment H.

Closing Comments

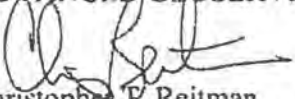
The points presented in this letter are based on over 20 years of experience during which NL and its consultants have analyzed data on sites like the RBS Site. We believe that the collection of additional data through techniques that assure its reliability, together with additional analysis in the Human Health and Ecological Risk Assessments will show:

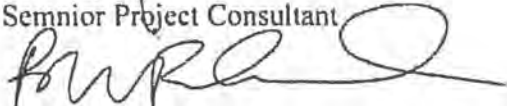
- 1) The slag is not leaching to surface water;
- 2) The groundwater has not been impacted by slag from the Site;
- 3) Treatment of the slag and/or a bottom liner will not be necessary because they will not result in a reduction of the actual risks at the Site;
- 4) Other sources of lead and arsenic exist in the area which contribute to the high site specific background concentrations calculated by EPA.
- 5) The conditions at the Site do not pose an unacceptable risk to human health; and
- 6) The ecological risks are manageable when appropriate concentrations and foraging areas are taken into consideration, and once source control is achieved.

We appreciate the opportunity to provide our comments on this Site. Please feel free to call the undersigned if you would like to discuss any of the issues raised in this letter in further detail.

Sincerely,

ADVANCED GEOSERVICES


Christopher P. Reitman
Senior Project Consultant


Barbara L. Forslund, P.E.
Consultant

CTR:BLF:kk



cc: Frank Cardiello, USEPA
Angela Carpenter, US EPA
Kevin Lombardozzi, NL Industries
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Chrsi Gibson, Archer & Greiner



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Schoof, RA; Yager, JW. 2007. "Variation of total and speciated arsenic in commonly consumed fish and seafood." *Hum. Ecol. Risk Assess.* 13 (5) :946-965.

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FIGURE

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- B Description of September 2008 Field Collection Procedures
- C Field Notes from Sampling - No Field Filtering
- D Monitoring Well Location Drawing
- E MW-10D Well Development Record Summary
- F MW-10D Purge Record Summary
- G Slag Crushing Machinery
- H Data Review Comments



FIGURE



ATTACHMENT A

Comparison of Total and Dissolved Surface Water Results



CORRECTLY SAMPLED 2011 SURFACE WATER DATA						
April 2011	Samples	Total Lead		Dissolved Lead		Percent Dissolved Lead
		Result	Q	Result	Q	
Area 2	A2-20-WO	3.8	J	0	U	0
	A2-226-WO	0	U	0	nc	nc
	A2-22-WO	2.4	J	0	U	0
	A2-23-WO	0	U	0	nc	nc
	A2-26-WO	0	U	0	nc	nc
	A2-31-WO	0	U	0	nc	nc
April 2011 Average						0

NL-RBS 000477



ATTACHMENT B

Description of September 2008 Field Collection Procedures

**SUMMARY LETTER REPORT
RARITAN BAY SLAG
OLD BRIDGE AND SAYREVILLE, NEW JERSEY**

CERCLIS ID No.: NJN000206276

EPA Contract No.: EP-W-06-072
Task Order No.: 0010-00
W.O. No.: 20401.032.010.2064
Document Control No.: RST 2-02-F-0821

January 2009

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Prepared by:

Weston Solutions, Inc.
Edison, New Jersey 08837

NL-RBS 000479

various sizes. The NJDEP report stated that it is possible that some of the finer waste materials comprising the seawall may have been included in the soil samples.

On April 24, 2008, EPA received a request from the NJDEP to evaluate the Laurence Harbor Seawall for CERCLA Removal Action consideration. On November 3, 2008, EPA received an amended request from the NJDEP to include the northern jetty (herein referred to as the western jetty) at the Cheesequake Creek Inlet in the overall scope.

Existing Analytical Data

On May 23, 2007, the NJDEP conducted a limited sampling event at the intersection of Margaret's Creek and Raritan Bay, along the seawall at the Old Bridge Waterfront Park, on the first two beaches located west of the seawall, and within the grassed portion of the park. The NJDEP collected a total of 37 surface soil samples for metals analysis only. Analysis indicated concentrations of lead that ranged from 8.1 mg/kg to 142,000 mg/kg; antimony (1.5 J [estimated] mg/kg to 12,900 mg/kg), arsenic (6.1 J mg/kg to 3,350 J mg/kg), and copper (16.6 J mg/kg to 709 J mg/kg) were also detected.

The NJDEP conducted a second sampling event on July 24, 2007 from the same general locations. NJDEP collected a total of 34 surface soil samples for metals analysis only. Analytical results indicated concentrations of lead that ranged from 3.1 J mg/kg to 545 J mg/kg; antimony (0.42 J mg/kg to 20.2 J mg/kg), arsenic (1.3 mg/kg to 24.5 mg/kg), and copper (1 J mg/kg to 39.7 mg/kg) were also detected.

Integrated Assessment (IA) Sampling Program

From September 10 through 16, 2008, WESTON personnel collected a total of 48 aqueous samples (including two environmental duplicate samples), 95 surface soil samples (including five environmental duplicate samples), 10 subsurface soil samples, and 84 sediment samples (including four environmental duplicate samples) from the Site.

The aqueous samples were collected adjacent to the seawall, between the western end of the seawall and the first jetty, between the third jetty and the eastern jetty at the Cheesequake Creek Inlet, within the Cheesequake Creek Inlet, west of the western jetty at the Cheesequake Creek Inlet, and from Margaret's Creek. The aqueous samples collected by WESTON were analyzed for Target Analyte List (TAL) metals and dissolved metals (excluding mercury, including tin) through the EPA Contract Laboratory Program (CLP).

The surface and subsurface soil samples were collected from throughout the Site, including the seawall, the western jetty at the Cheesequake Creek Inlet, as well as the beach, park, and playground areas. The soil samples were analyzed for TAL metals and Toxicity Characteristic Leaching Procedure (TCLP) metals through the EPA CLP.

The sediment samples were collected within Margaret's Creek, between Margaret's Creek and the western end of the seawall, between the third jetty and the eastern jetty at the Cheesequake Creek Inlet, within the Cheesequake Creek Inlet, and west of the western jetty at the Cheesequake Creek Inlet. Six of the sediment samples were collected approximately 0.5 mile east of Margaret's Creek

as background samples. The sediment samples were analyzed for TAL metals through the EPA CLP. Grain-size distribution analysis was conducted by a private, subcontracted laboratory. Site Figures and the Sampling Trip Report are presented in Appendices A and B, respectively.

Sample Analytical Results

Analytical results for soil samples indicated the presence of lead at extremely elevated levels on the western jetty of the Cheesequake Creek Inlet. Four surface (0-2 inches) soil samples ranged from 54,800 mg/kg to 198,000 mg/kg. The maximum concentrations of antimony, arsenic, and copper detected at the western jetty were 3,120 mg/kg; 2,470 mg/kg; and 4,630 mg/kg, respectively. Two subsurface (one at 6-12 inches and one at 12-18 inches) soil samples indicated the presence of lead at a maximum concentration of 731 mg/kg. The maximum concentrations detected in the subsurface soil samples for antimony, arsenic, and copper were non-detect, 15.4 J mg/kg, and 76.6 mg/kg, respectively.

Four surface soil samples collected from an area west of the western jetty of the Cheesequake Creek Inlet indicated the presence of lead; concentrations ranged from 231 mg/kg to 14,200 mg/kg. The maximum concentrations detected in surface soil samples for antimony, arsenic, and copper were 616 mg/kg, 198 J mg/kg, and 340 mg/kg, respectively. One subsurface (6-12 inches) soil sample from this area indicated the presence of lead at 21,500 mg/kg. The concentrations detected in the subsurface soil sample for antimony, arsenic, and copper were 419 mg/kg, 228 J mg/kg, and 489 mg/kg, respectively.

Six surface soil samples collected from the beach area along the seawall indicated the presence of lead; concentrations ranged from 44.8 J mg/kg to 1,600 J mg/kg. The maximum concentration detected for copper was 74.4 J mg/kg. All antimony and arsenic concentrations, which ranged from 6.1 R (rejected) mg/kg to 152 R mg/kg and 1.2 R mg/kg to 72.8 R mg/kg, respectively, were subsequently rejected as unusable during the data validation process due to quality control issues. Three subsurface (6-12 inches) soil samples indicated the presence of lead; concentrations ranged from 22.5 J mg/kg to 1,100 J mg/kg. The maximum concentration detected for copper was 51.4 J mg/kg. All antimony and arsenic concentrations, which ranged from 6.3 R mg/kg to 100 R mg/kg and 1.6 R mg/kg to 53.9 R mg/kg, respectively, were subsequently rejected as unusable during the validation process due to quality control issues. Five surface soil samples collected from an area between Margaret's Creek and the eastern end of the seawall indicated the presence of lead; concentrations ranged from 11.4 J mg/kg to 10,200 J mg/kg. The maximum concentrations detected for antimony, arsenic, and copper were 120 mg/kg, 48.3 mg/kg, and 186 J mg/kg, respectively.

Seventeen surface soil samples collected from the beach area between the western end of the seawall and the first jetty indicated the presence of lead; concentrations ranged from 57.9 J mg/kg to 1,630 J mg/kg. Four subsurface soil samples (two at 6-12 inches and two at 12-18 inches) ranged from 649 J mg/kg to 23,800 J mg/kg. The maximum concentrations detected for antimony, arsenic, and copper were 832 mg/kg, 602 mg/kg, and 704 mg/kg, respectively.

Ten surface soil samples collected from the beach area between the first and second jetty indicated the presence of lead; concentrations ranged from 109 J mg/kg to 935 J mg/kg. The maximum concentration detected for copper was 75.7 J mg/kg. All antimony and arsenic concentrations, which ranged from 3.6 R mg/kg to 15.4 R mg/kg and 4.5 R mg/kg to 37.5 R mg/kg, respectively,

were subsequently rejected as unusable during the data validation process due to quality control issues.

Nineteen surface soil samples collected from the beach area between the third jetty and the eastern jetty of the Cheesequake Creek Inlet indicated the presence of lead; concentrations ranged from 1.7 J mg/kg to 94.1 J mg/kg. The maximum concentrations detected for antimony, arsenic, and copper were non-detect, 9.2 mg/kg, and 15 mg/kg, respectively.

Six soil samples collected from the beach area, parallel to the inlet, on the eastern side of the Cheesequake Creek Inlet, indicated the presence of lead; concentrations ranged from 1.8 mg/kg to 4.4 mg/kg. The six samples indicated non-detect values for antimony. All arsenic and copper concentrations, which ranged from 1.8 R mg/kg to 5.4 R mg/kg and 1.0 R mg/kg to 2.0 R mg/kg, respectively, were subsequently rejected as unusable during the data validation process due to quality control issues.

Twenty-four surface soil samples collected from the park and the playground area indicated the presence of lead; concentrations ranged from 8.9 J mg/kg to 97.8 J mg/kg. The maximum concentrations detected for antimony, arsenic, and copper were 0.42 J mg/kg, 144 mg/kg, and 131 J mg/kg, respectively.

Thirteen soil samples were analyzed using the TCLP. The Resource Conservation and Recovery Act (RCRA) limit for lead (5 milligrams per liter [mg/L]) was exceeded in 9 of the 13 samples. All five soil samples collected at the western jetty of the Cheesequake Creek Inlet, and west of the western jetty, exceeded this limit. The soil results for the western jetty exceeded the limit by a magnitude of approximately 100 to 250 times. The remaining exceedances were all from the seawall area.

Sediment samples collected west of the western jetty of the Cheesequake Creek Inlet indicated the presence of lead in nine samples; concentrations ranged from 29.6 mg/kg to 2,150 mg/kg; two samples with concentrations of 2,910 R mg/kg and 4,130 R mg/kg were subsequently rejected as unusable during the data validation process due to quality control issues. The maximum concentrations detected for antimony, arsenic, and copper were 53.7 J mg/kg, 62.9 J mg/kg, and 204 J mg/kg, respectively.

Both sediment samples collected from the Cheesequake Creek Inlet, close to the western jetty, which were identified to contain 42,200 R mg/kg and 89,200 R mg/kg of lead, were subsequently rejected as unusable during the data validation process due to quality control issues. It should be noted that the quality control issue was related to a low recovery on the matrix spike sample. The maximum concentrations detected for antimony, arsenic, and copper were 3,270 mg/kg; 2,100 J mg/kg; and 2,050 J mg/kg, respectively.

Twenty-one sediment samples collected from the beach area between the third jetty and the eastern jetty at the Cheesequake Creek Inlet indicated the presence of lead; concentrations ranged from 1.2 J mg/kg to 11.4 mg/kg. One sample indicated the presence of lead at 21.2 R mg/kg, but was subsequently rejected as unusable during the data validation process due to quality control issues. The maximum concentrations detected for antimony, arsenic, and copper were 0.86 J mg/kg, 3.7 mg/kg, and 11.0 J mg/kg, respectively.



ATTACHMENT C

Field Notes from Sampling - No Field Filtering

Raritan Bay Slag

9/11/08

0845 DG & NM discuss plan for day.
Will collect samples from seawall to
first jetty, soil & SW, first to
second jetty soil, and then complete
sediment samples in front of seawall.

JM & KS complete playground and
park samples. Will assist on beach
samples now

(W) 0900 Continue to collect soil samples
from beach.

0930 Continue to collect soil samples
from beach.

1000 DG & NM go to beach between first
and second jetty and lay out 10
beased locations.

1010 Complete collecting samples between
seawall and first jetty.

DW/R 9/11/08

(13/08/08)

Raritan Bay Slag

Date: 9/11/08

19

1015- JM & KS go to collect samples
from beach between first & second
jetty.

1030- DG, KL, & MF go to collect SW
samples between seawall & first
jetty.

1100- Complete Activity-based surface
water samples. Also complete
soil samples between first & second
jetty.

1110 Will collect sediment samples
from beach area. 3 transects out into
water, 21 transects perpendicular to
beach. 12 total samples
A fourth transect was added
perpendicular from beach by IX.
Sediment samples 81, 82 & 83,
change in work plan.

1125 Begin collecting sediment samples

DW/R 9/11/08



ATTACHMENT D

Monitoring Well Location Drawing

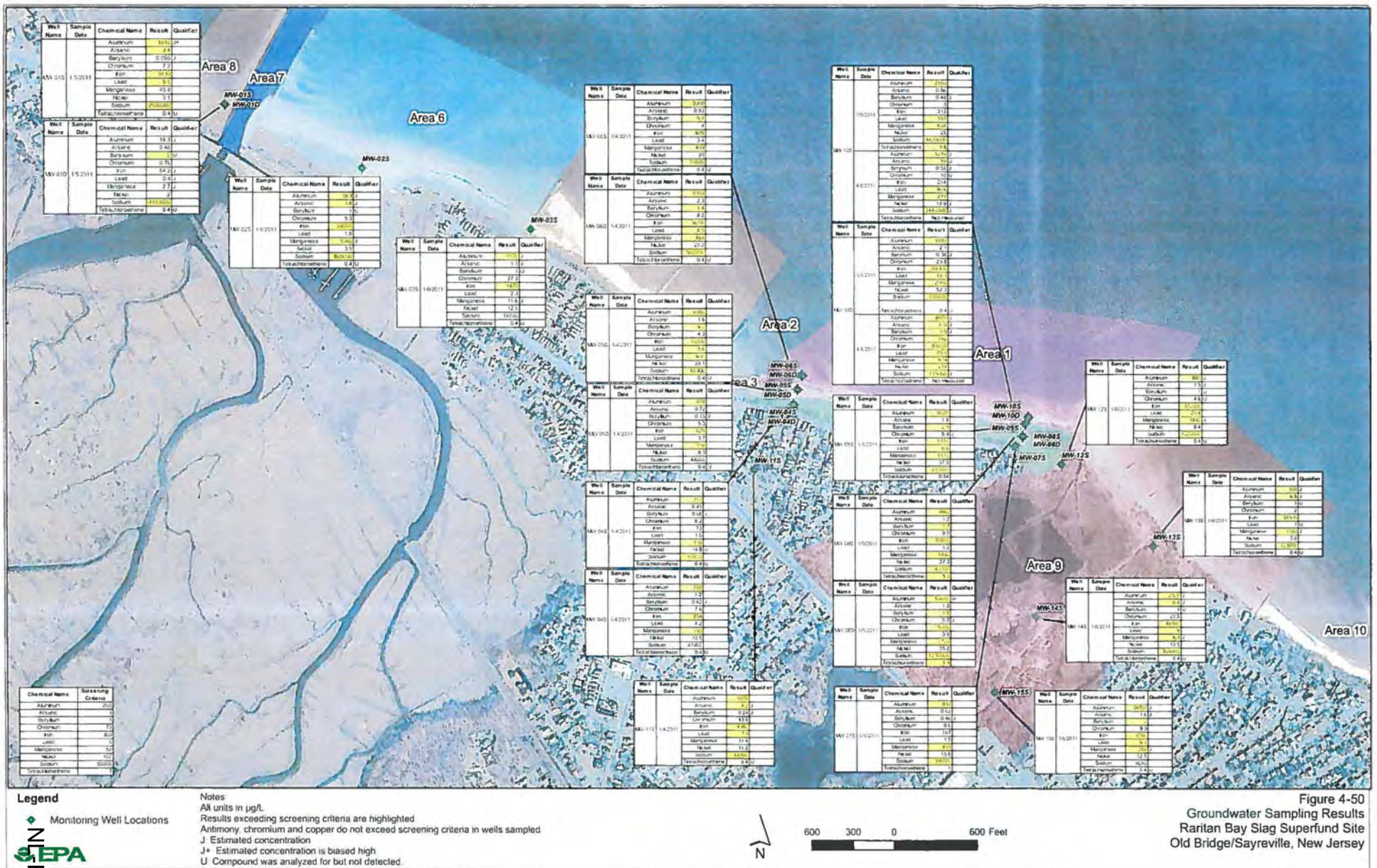


Figure 4-50
Groundwater Sampling Results
Raritan Bay Slag Superfund Site
Old Bridge/Sayreville, New Jersey



ATTACHMENT E

MW-10D Well Development Record Summary

LOW FLOW GROUNDWATER SAMPLING PURGE RECORD

Ranlan Bay Slag Site

DATE: 10/28/10

SAMPLERS: Allan Hunter

WEATHER CONDITIONS:

SAMPLE ID:
CLP ID:

WELL #: MW-10D

DEPTH OF PUMP INTAKE:

ft TIC or ft BGS (circle one)

DTW = 7.32'
TD = 400' AH 40'

SCREENED/OPEN BOREHOLE INTERVAL:

ft TIC or ft BGS (circle one)

Well Development

SAMPLE TIME:

SAMPLE FLOW RATE:

ml/minute

Instrument Type/Model:
Complete and/or Circle at right

YSI Model # _____ / Horiba U-22 (circle one)
Other (specify) _____

Instrument:

CURRENT TIME	VOLUME PURGED	DEPTH TO WATER	FLOW RATE	DRAWDOWN (± 0.3 FT)	pH (± 0.1 SU)	SPECIFIC CONDUCTIVITY (± 3%)	DISSOLVED OXYGEN (± 10%)	TEMP. (± 10%)	REDOX POTENTIAL (± 10 mV)	TURBIDITY (± 10%)
24-Hour	gallons / liters (circle one)	ft TIC / ft BGS (circle one) Units: ft BGS or	Units:	ft TIC / ft BGS (circle one)	SU	S/cm, mS/cm ² or µS/cm (circle one)	mg/L (not %)	Units: °C	mV	NTUs
WDry 1320		23.00			6.73	2.217	1.02	14.19	6.6	Err 3 AH Er3
1400		24.40			5.66	2.138	2.44	14.23	21.2	Er3
1440		26.00			5.39	3.170	2.07	14.38	50.8	Er3
1443		28.00			5.25	3.279	2.10	14.58	48.4	Er3
1446 AH										Er3 AH
1500		32.70			5.13	2.459	5.41	14.70	65.4	Er2
1503		39.10			5.32	3.045	2.71	14.33	62.8	Er3
1506					5.26	3.242	2.70	14.81	67.9	

Drawdown is not to exceed 0.3 feet. Flow rate should not exceed 500 ml/min during purging or 250 ml/min during sampling. Readings should be taken every three to five minutes. The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis.

Typical values:

DO = 0.3 - 10 mg/L

Redox Potential = -100 - +600 mV

Turbidity = 0 - >500 NTUs

Spec. Conductivity (µS/cm) = 0.01 - 5,000; up to 10,000 in industrial, ~55,000 in high salt content water. Note: 1,000 µS/cm = 1 mS/cm

TIC = Top of Inner Casing

BGS = Below Ground Surface

Well keeps going dry must continuously wait or it to resurge.



ATTACHMENT F

MW-10D Purge Record Summary

**LOW FLOW GROUNDWATER SAMPLING PURGE RECORD
RARITAN BAY SLAG SITE**

10f2

DATE: 4/6/11

WELL #: 10D

SAMPLERS: EK

DEPTH OF PUMP INTAKE: 34 ft TIC or BGS (circle one)

WEATHER CONDITIONS: SUNNY, WINDY 40°F

SCREENED/OPEN BOREHOLE INTERVAL: 29-39 ft TIC or BGS (circle one)

SAMPLE ID: MW-10D-04-06-2011

SAMPLE TIME: 1340 SAMPLE FLOW RATE: 250 ml/minute

CLP ID: M08NY 7

Instrument Type/Model:
Complete and/or Circle at right

YSI Model # 650 / Horiba U-22 (circle one)
Other (specify) _____

Instrument:
2020

CURRENT TIME	VOLUME PURGED	DEPTH TO WATER	FLOW RATE	DRAWDOWN	pH	SPECIFIC CONDUCTIVITY	DISSOLVED OXYGEN	TEMP.	REDOX POTENTIAL	TURBIDITY	
				(± 0.3 FT)	(± 0.1 SU)	(± 3%)	(± 10%)	(± 10%)	(± 10 mV)	(± 10%)	
24-Hour	gallons / <u>liters</u> (circle one)	ft TIC / R BGS (circle one) Units: ft bgs or TIC (circle one)	Units: <u>ml/min</u>	R TIC / R BGS (circle one)	SU	S/cm, (mS/cm) or µS/cm (circle one)	mg/L (not %)	Units: °C	mV	NTUs	
1055		6.46	250		7.07	0.890	1.75	12.83	40.6	270	0.45
1120		15.42	200		6.28	0.909	1.34	13.14	91.9	340	0.45
1125		15.61	200		6.16	0.925	1.25	13.41	102.2	400	0.45
1130		21.74	200		5.99	0.938	1.44	13.80	97.9	320	0.47
1135		28.31	200		5.95	0.910	1.15	13.73	98.6	400	0.46
1140		28.42	200		5.91	0.912	1.16	13.77	100.1	253	0.46
1145		31.62	200		5.88	0.915	1.17	13.80	103.3	900	0.48
1150		33.86	200		5.86	0.929	1.69	14.14	98.1	500	0.49
1155		DRY									
SHUT PUMP OFF TO LET well RECHARGE											

Drawdown is not to exceed 0.3 feet. Flow rate should not exceed 500 ml/min during purging or 250 ml/min during sampling. Readings should be taken every three to five minutes. The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis. Typical values: DO = 0.3 - 10 mg/L Redox Potential = -100 - +600 mV Turbidity = 0 - >500 NTUs

Spec. Conductivity (µS/cm) = 0.01 - 5,000; up to 10,000 in industrial, ~55,000 in high salt content water. Note: 1,000 µS/cm = 1 mS/cm
TIC = Top of Casing BGS = Below Ground Surface

NL-RBS 000490

**LOW FLOW GROUNDWATER SAMPLING PURGE RECORD
RARITAN BAY SLAG SITE**

20F2

DATE: 4/6/11

WELL #: MW-100

SAMPLERS: EK

DEPTH OF PUMP INTAKE: 34 ft TIC or ft BGS (circle one)

WEATHER CONDITIONS: Sunny, Windy 40°F

SCREENED/OPEN BOREHOLE INTERVAL: 29-39 ft TIC or ft BGS (circle one)

SAMPLE ID: MW-100-0406-2011 SAMPLE TIME: 1340 SAMPLE FLOW RATE: 250 ml/minute

CLP ID: MB8NY7

Instrument Type/Model:
Complete and/or Circle at right

YSI Model # 650 / Horiba U-22 (circle one)
Other (specify) _____

Instrument:
2020

CURRENT TIME	VOLUME PURGED	DEPTH TO WATER	FLOW RATE	DRAWDOWN	pH	SPECIFIC CONDUCTIVITY	DISSOLVED OXYGEN	TEMP.	REDOX POTENTIAL	TURBIDITY
				(± 0.3 FT)	(± 0.1 SU)	(± 3%)	(± 10%)	(± 10%)	(± 10 mV)	(± 10%)
24-Hour	gallons / liters (circle one)	ft TIC / ft BGS (circle one) Units: ft bgs or TIC (circle one)	Units: ML/min	ft TIC / ft BGS (circle one)	SU	S/cm (MS/cm²) or µS/cm (circle one)	mg/L (not %)	Units: °C	mV	NTUs
1248		18.31	200		5.90	0.880	1.19	14.19	76.5	7999
1255		18.38	200		5.91	0.851	0.82	14.36	21.3	7999
1300		18.42	200		5.92	0.836	0.52	14.55	-19.3	7999
1305		18.84	200		5.90	0.851	0.54	14.87	-21.9	7999
1310		19.01	200		5.89	0.866	0.56	15.03	-25.4	7999
1330		19.61	200		5.84	0.904	0.53	15.00	-44.1	7999
well is NOT clearing up, we will take EXTRA VOLUME FOR SAMPLES										

Drawdown is not to exceed 0.3 feet. Flow rate should not exceed 500 ml/min during purging or 250 ml/min during sampling. Readings should be taken every three to five minutes. The well is considered stabilized and ready for sampling when the indicator parameters have stabilized for three consecutive readings by the measurements indicated in parenthesis. Typical values: DO = 0.3 - 10 mg/L Redox Potential = -100 - +800 mV Turbidity = 0 - >500 NTUs Spec. Conductivity (µS/cm) = 0.01 - 5,000; up to 10,000 in industrial, ~55,000 in high salt content water. Note: 1,000 µS/cm = 1 mS/cm TIC = Top of Inner Casing BGS = Below Ground Surface



ATTACHMENT G

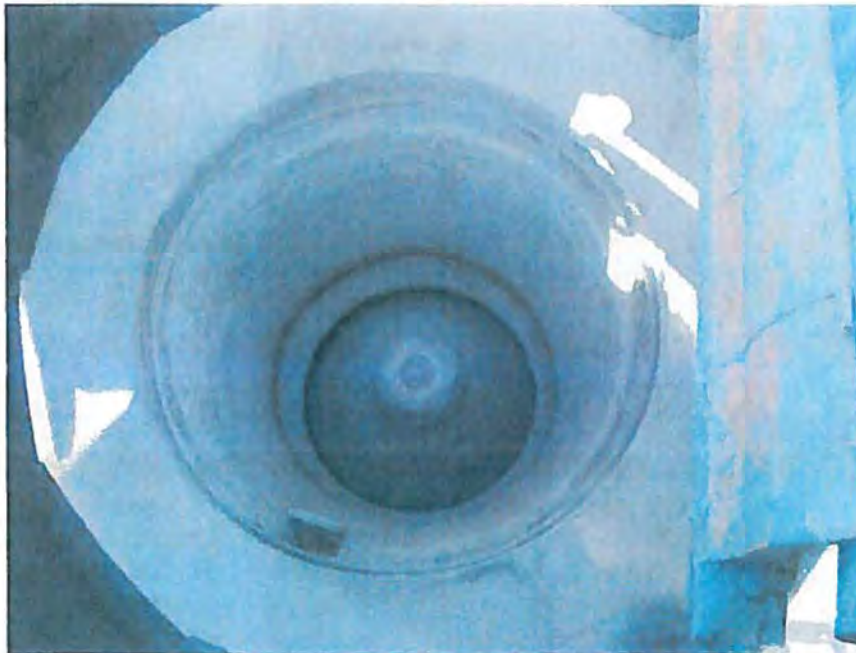
Slag Crushing Machinery



PHOTOGRAPH 6(a)

LOCATION:

Phoenix METSO cone crusher
perspective, oblique side view.



PHOTOGRAPH 6(b)

LOCATION:

Phoenix METSO cone crusher,
top view of cone crusher feed
hopper.



RARITAN BAY SLAG SUPERFUND SITE
CDM
OLD BRIDGE AND SAYREVILLE, NJ
PROJECT NO. 10615032

PHOTOGRAPHS

NL-RBS 000493



PHOTOGRAPH 7(a)

LOCATION:

Slag coring activity, borehole illustrating internal vesicle structure in slag.



PHOTOGRAPH 7(b)

LOCATION:

Slag coring activity, core sample.



RARITAN BAY SLAG SUPERFUND SITE
CDM
OLD BRIDGE AND SAYREVILLE, NJ
PROJECT NO. 10615032

PHOTOGRAPHS



ATTACHMENT H

Additional Comments On Background



APPENDIX H

ADDITIONAL COMMENTS ON BACKGROUND

- A. Despite finding Site specific background condition which exceeded their screening standard by a factor of over 5, EPA did not consider other potential sources of arsenic and lead in the RI such as farming in the wetlands and upland areas.

For instance, the Old Bridge Borough website states:

From about 1770 on salt hay [salt hay], which consisted of cord grasses and reed grasses was regularly dried and used as a packing and insulating material. Photographs of the waterfront taken in the late 19th and early 20th centuries reveal extensive stands of cord grass along most of the two mile waterfront. (Reference: Old Bridge History, www.oldbridge.com, February, 2012)

Further, other Raritan Bay websites document:

The building of shore management structures (dikes, groins, seawalls), the spraying of DDT (and other pesticides) to control the mosquito problem, the carving of ditches to drain wetlands, the filling of shore lowlands, the channelization of creeks, highway construction, sewer construction, neighborhood construction, and a myriad of point and non-point sources of household, automobile, industrial chemicals, and ocean dumping all contributed to growing toxicity and the bay. (Reference: A Brief Natural History of Raritan Bay, www.geo.hunter.cuny.edu, February, 2012)

Figure H-1 highlights the straight channel dewatering features found in the upslope area of the Site which were utilized to control water levels for farming purposes. Any pesticides or herbicides sprayed on these areas would have drained through the Site leaving a residual contamination in its drainage pathways, including Margaret's Creek.

- B. Wetland marshes, like the one found in Area 9, act as natural filters for contaminants and nutrients. Metals like arsenic and lead accumulate on the bottom of these areas, sorbed onto the high organics present. Given the high background of these metals in the area, it is no surprise that elevated concentrations have been identified and many of the hotspots are located within the marsh where the farmed upslope drainage areas would have drained, passing sediments with herbicides/pesticides with lead and arsenic into the marsh. Without upslope site sampling of the marsh, it is impossible to understand the other potential influences which have contributed to slag conditions in the marsh.



- C. The limited upslope sampling in Area 9 sediments seems to support this understanding of areas upland of Area 9 contributing lead and arsenic. Significant arsenic and lead concentrations, exceeding the Site screening levels were identified in the most upslope portions of Area 9, as shown on Figure H-2. These upslope areas are inaccessible to construction equipment and are not located along likely migration pathways from the identified source material as shown on the figure. It appears migration from upslope, non-Site related sources is the most likely way these areas became impacted. Further, as shown on the drawings, there is no trail of evidence leading back to the identified source areas of the Site (i.e., a transport pathway with elevated residual concentrations) suggesting these compounds came from the identified source areas. It was also noted several of the samples exceeded the lead/arsenic screening levels at depths greater than 6", with clean samples above, suggesting that the deposition pattern is of a historical nature, with higher concentrations from a previous period of higher pesticide/herbicide use upland of the Site, with cleaner, more recent sediments deposited on top, which is associated with more recent upslope Site use patterns.
- D. Although not directly related to the background discussions above, the area selected for soil background, the beach in Area 10, is not at all comparable to the upland areas of the Site such as the Margaret's Creek uplands since beach sand is low in the organic matter that tends to bind arsenic and lead in the soil. For the same reason that no one would compare unvegetated beach sands to topsoil, it is mistake to consider background from a beach to be similar to background from a vegetated site like most of Area 9. A more appropriate soil background area would be an upland area adjacent to the Whale's Creek wetlands.



ATTACHMENT I DATA REVIEW COMMENTS

The presentation of the data in the Final Remedial Investigation Report for the Raritan Bay Slag Superfund Site was difficult to understand. The issues noted were as follows:

- The data tables in Section 4.0 for surface water contain the 2008 and 2009 data collected by Weston Solutions. There is no distinction made between the regular surface water samples and the activity-based surface water samples. The activity-based samples contain biased high concentration of metals since the samples were collected after the bottom sediments were agitated prior to collection of the surface water.
- For the fall 2010 data (collected October-December), a significant portion of the surface water metals data was rejected due to matrix interferences. More than 79% of the surface water data collected for antimony, lead, selenium, and thallium were rejected leaving only 21% useable.
- Within the report text and tables, there is no statistical presentation of the data (in total, by matrix, and/or by area) that would determine whether the data was statistical significant or if there were statistical trends.
- The data tables in Section 4.0 were to contain "the data that exceeded the screening criteria." This data includes detected sample results with their respective concentrations, but it also contains non-detected samples with the "U" qualifier and reporting limit (in some cases only the "U" qualifier is present and not the reporting limit) and rejected data. Rejected data should not be used in a presentation of data that exceed screening criteria. Samples that were not detected, but the reporting limit exceeds the screening criteria does not provide any information except that a more sensitive method (if available) should have been used to get reportable data below the screening criteria.
- The Table 4-20a in Section 4.0 is identified as the total metal results from Area 02 that exceeded screening criteria. This table also contains dissolved metals (Al, As, Ba, Ca, Fe, Mg, Mn, Ni, K, V, and Zn) results for samples (A2-20-WO, A2-226-WO, A2-22-WO, A2-23-WO, A2-26-WO, and A2-31-WO) that were collected on 4/6/2011. In the associated dissolved metals Table 4-20b, only the dissolved mercury results from A2-20-WO and A2-23-WO were reported. The other dissolved metals data contained in Table 4-20a have not been included.



- The files on the RI compact disk contain two sets of Appendices M-Q. The first set is a folder with the data in Area-specific PDFs. The second set is a stand-alone PDF of each Appendix. Both sets of tables have the compound names listed only on the first page of the inorganic and organic tables by area, which makes reading these tables very difficult past Page 1.
- In Appendix N – Surface Water, the data for June 2011 has been presented, but the reporting limits for non-detected compounds are not listed. It is impossible to tell if better reporting limits were achieved for the re-analyzed samples. The June 2011 data also seems to indicate that new samples were collected rather than having samples from the fall 2010 event reanalyzed since the date collected indicates a June 1, 2011 date as indicated in the first paragraph in Chapter 4.0. If these samples are from archived samples that were collected in the fall 2010 event, then the date collected would still be from that time frame rather than June 2011.
- In the ecological and human health risk assessments, the newer surface water data collected by CDM in May 2010, April 2011, and June 2011 appear to have been omitted. A reference to this data was made, but not incorporated in the risk assessments. This is significant since this is a more comprehensive data set than most of the older data. This is because fewer sample results were rejected and the non-detected data had reporting limits closer to or lower than the screening criteria.

We appreciate that the USEPA provided us with the Excel[®] data table, without which our interpretation of the data would not have been possible.

Exhibit M

John Powers

From: Courtney Riley
Sent: Monday, October 29, 2012 3:41 PM
To: John Powers
Subject: FW: RBS RI Data--Groundwater issue

From: Christopher Reitman [mailto:creitman@advancedgeoservices.com]
Sent: Thursday, February 02, 2012 4:20 PM
To: cgibson@archerlaw.com
Cc: Courtney Riley; Kevin Lombardozi; bforslund@advancedgeoservices.com
Subject: FW: RBS RI Data--Groundwater issue

[Privileged and Confidential](#)

Groundwater Issue Summary

From: Tanya Mitchell [mailto:Mitchell.Tanya@epamail.epa.gov]
Sent: Wednesday, July 13, 2011 12:36 PM
To: Christopher Reitman
Subject: Re: RBS RI Data

Chris,

I have reviewed your evaluation of the GW data and your suggestion to conduct additional GW sampling. The analytical results demonstrates that there is an impact to GW. However, these results could be an anomaly or a false positive as you suggest. At this time, EPA does not believe the GW is a risk driver in the absence of the slag.

Since, there is sufficient GW data to complete the RI/FS, the remedy will be managed with this anomaly in mind and EPA will continue to evaluate the GW conditions. Thus, there does not appear to be an advantage to collecting additional GW samples at this time.

Please give me a call or reply to this email if you would like to discuss this matter further.

Regards,

Tanya

-----creitman@agcinfo.com wrote: -----

To: Tanya Mitchell/R2/USEPA/US@EPA
From: creitman@agcinfo.com
Date: 06/30/2011 05:45PM
Subject: Re: RBS RI Data

Tanya, Let me know a time which works for you. Chris

Sent from my Verizon Wireless BlackBerry

From: Tanya Mitchell <Mitchell.Tanya@epamail.epa.gov>
Date: Thu, 30 Jun 2011 15:41:03 -0400
To: <creitman@advancedgeoservices.com>
Subject: RE: RBS RI Data

Hi Chris,

EPA appreciates your review and evaluation of the GW data. I would like to discuss your comments and recommendations with the EPA technical team. There are a few of us that will be out of the office next week for the holiday. So please give me a few days to meet with the team and get back to you with a response.

Regards,

Tanya

-----"Christopher Reitman" <creitman@advancedgeoservices.com> wrote: -----

To: Tanya Mitchell/R2/USEPA/US@EPA
From: "Christopher Reitman" <creitman@advancedgeoservices.com>
Date: 06/29/2011 02:29PM
Subject: RE: RBS RI Data

Tanya,

Thank you for the data. It is a tremendous help in understanding the situation. As I mentioned during our meeting, we have a significant body of work experience on similar sites collecting similar metals data. Measuring ppb levels of compounds can be very tricky and extremely small amount of turbidity in samples have created false positives on at least 5 sites we have been involved with. Based on the data you sent me, and the information in the project workplan, I believe it is possible the turbidity may be creating false positives and mis-characterizations at the RBS Site.

To help understand the data, I went back and looked at the workplan to understand how the data was developed. I have attached the page from the work plan which describes how a Grunfos Rediflow 2 pump (which pumps 1 to 8 gpm) is first plunged into the well to purge it and then, after purging, the Grunfos Rediflow 2 pump is extracted and a different pump, a low flow bladder pump (which pumps about 0.1 gpm), is plunged into the well to get a sample. Both the insertion of 2 pumps in the wells prior to sampling and the high pumping rate of the Rediflow pump are extremely disruptive to the water column in the well and create a high degree of undesirable mixing and turbidity. If this is how the sampling was actually done, there is likely significant turbidity created and the samples are not likely representative of the formation. I also note this purging with a Grunfos redi-flow pump is inconsistent with the NJDEP Field Sampling Procedures Manual (NJDEP, 2005, p. 95 - 118). As previously noted our experience is that this turbidity drastically affects the results and contributes to false positive readings. We have experienced very similar turbidity related mis-characterizations and false positive readings on the Jack's Creek Superfund Site, Tonolli Superfund Site, CDS/I-port 440 site, and smelter sites in Tennessee and Indiana. On at least three of these sites EPA initially believed a lead plume existed and the high lead concentrations in the initial site samples were later proven to be related to high turbidity and poor sampling techniques.

On the data you sent me I also noted that:

- Many of the samples had high aluminum and iron, which could also be from the fine soil particles creating the turbidity in the wells. These are commonly occurring elements in soil and would be expected to be high in the fine soil particles which create turbidity.

- The lead concentrations on the drawing you sent me did not show a consistent pattern suggesting a plume. Rather the pattern of lead concentrations (or more accurately the lack of a pattern) looked very random, with wells like MW-11S, which represents background in the middle of the residential area, exceeding the EPA standard. It is my opinion that this random pattern of lead concentrations may have been more influenced by the turbidity in the wells at the time of sampling than the lead in the groundwater.

At this time I have the following thoughts to better understand the previous sampling results:

- I would suggest checking to see if the original samples are still at the lab. Lead has a 6 month holding time, so these samples could be reanalyzed for both total and dissolved metals, which would help to understand whether the elevated lead concentrations may be related to turbidity. This would be the best way to help understand the situation and the potential for turbidity to contribute to mischaracterizations of site groundwater conditions for metals.
- I would suggest checking the field books from the sampling to see if there really were two pumps inserted into each well as part of the procedure, creating turbidity.
- I would also check the field book to determine how much water was generated during purging and whether the turbidity field measurements were less than 10 NTUs during sampling. The series of readings of the turbidity and pH parameter taken during sampling to show these parameters had stabilized would be very helpful supporting data. Also, the turbidity at individual wells could be compared to the metals concentrations to identify whether a pattern of turbidity and high metals is observed.

If you can provide copies of the field notebooks or sampling summary sheets completed by the field samplers, this would help me to understand whether the lead really is dissolved in groundwater, or as I suspect, may be related to false positives due to the turbidity created during sampling. I would also suggest another round of sampling be done utilizing only low flow pumps for both sampling and for purging and with splits of the samples for total and dissolved metals. If you would allow NL access to the site, we would be interested in completing this sampling and providing split samples for EPA or working with EPA personnel doing the sampling.

I think utilization of artificially high lead concentrations in groundwater in the RI/FS analysis may potentially lead to erroneous statements and conclusions regarding site conditions. For this reason I feel addressing this situation is critical to developing an accurate and supportable Site characterization. I know EPA has spent a considerable effort characterizing the site and wants a high degree of confidence in the results before presenting them to the public.

I hope my experiences on large metal sites and my comments are helpful to the RI/FS process. If you or your team would like to discuss this further, please feel free to call or email.

Chris

From: Mitchell.Tanya@epamail.epa.gov [mailto:Mitchell.Tanya@epamail.epa.gov]
Sent: Wednesday, June 29, 2011 8:27 AM
To: Christopher Reitman
Subject: RE: RBS RI Data

Hi Chris,

It was nice to meet you and here your recommendations for the seawall. The groundwater data you requested is attached. Please let me know if you need any additional information.

Thanks,

Tanya

-----"Christopher Reitman" <creitman@advancedgeoservices.com> wrote: -----

To: Tanya Mitchell/R2/USEPA/US@EPA
From: "Christopher Reitman" <creitman@advancedgeoservices.com>
Date: 06/07/2011 03:12PM
Subject: RE: RBS RI Data

Tanya, Thanks for the brief update of conditions. I am interested in the potential leaching of the seawall slag, the distribution of the slag and other materials near the seawall and the impact of the slag on the soils within the park and the groundwater going to the ocean.

I understand from our discussions there may be traces of battery casings in the park fill behind the seawall, but any impacts from lead appear to be limited and are not pervasive. I also understand your results show the slag is leaching into the ocean, but there is only one sample which shows the slag may be impacting the underlying groundwater. This well is being resampled.

To assist me in our review of site conditions, I understand you will forward me:

- The test-pit summary report,
- Any additional information regarding your groundwater results, particularly MW-5S/D, MW-6S/D, MW-9 S/D, MW-10 S/D
- Any other information collected regarding the condition of the park soils behind the seawall.

I appreciate your assistance on this matter and will look forward to receiving the test-pit summary report.

Chris Reitman

-----Original Message-----

From: Mitchell.Tanya@epamail.epa.gov
[<mailto:Mitchell.Tanya@epamail.epa.gov>]
Sent: Monday, June 06, 2011 3:09 PM
To: Christopher Reitman
Cc: Gibson, Christopher; Cardiello.Frank@epamail.epa.gov
Subject: Re: RBS RI Data

Hello Christopher,

Thank you for your interest in the Raritan Bay Slag Superfund site. As you are aware, EPA is conducting a Remedial Investigation and Feasibility Study at the site. Sampling activities at the site were conducted fall of 2010 through spring 2011. Currently, EPA is in the process of reviewing and evaluating the data. Thus, no formal findings or determinations have been made pertaining to the data and, therefore, a meeting at this time would be premature.

I expect that by late July I will have a better understanding of the data and should be able to provide you with specific details of the site contaminants at that time. There are several documents available for public review on EPA's website at:
<http://www.epa.gov/region2/superfund/npl/raritanbayslag/>.

I also understand that at NL Industries request, Frank Cardiello is attempting to set a meeting in the near future. I will be attending that meeting and will provide an update on available information at that time.

Regards,

Tanya

From: "Christopher Reitman" <creitman@advancedgeoservices.com>
To: Tanya Mitchell/R2/USEPA/US@EPA
Cc: "Gibson, Christopher" <cgibson@archerlaw.com>
Date: 06/03/2011 08:19 AM
Subject: RBS RI Data

Tanya, I am working with NL at the RBS Site. I am told by Chris Gibson, NL's outside counsel, that you are the EPA RPM overseeing the work. I am interested in informally discussing the findings from your investigations, particularly near the seawall. Would it be possible to schedule a meeting sometime next week to discuss your results? If so, please advise a date which might work for you.

Regards,

Christopher T. Reitman P.E.
Principal
Advanced GeoServices
"Engineering for the Environment. Planning for People."™
1055 Andrew Drive, Suite A
West Chester, PA 19380-4293
Direct 610.840.9123

Fax 610.840.9199

Mobile 610.389.2469 Email creitman@advancedgeoservices.com

[attachment "WP-GW-Sampling-Proc.pdf" removed by Tanya Mitchell/R2/USEPA/US]

Exhibit N



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

July 5, 2012

MEMORANDUM

SUBJECT: National Remedy Review Board Recommendations for the Raritan Bay Slag Superfund Site

FROM: Amy R. Legare, Chair
National Remedy Review Board

A handwritten signature in cursive script, reading "AR Legare", is positioned to the right of the "FROM:" line.

TO: Walter E. Mugdan, Director
Superfund Division
U.S. EPA Region 2

Purpose

The National Remedy Review Board (the Board) has completed its review of the proposed cleanup action for the Raritan Bay Slag Superfund site, in Old Bridge/Sayreville, New Jersey. This memorandum documents the Board's advisory recommendations.

Context for Board Review

The Administrator established the Board as one of the October 1995 Superfund Administrative Reforms to help control response costs and promote consistent and cost-effective remedy decisions. The Board furthers these goals by providing a cross-regional, management-level, "real time" review of high cost proposed response actions prior to their being issued for public comment. The Board reviews all proposed cleanup actions that exceed its cost-based review criteria.

The Board review is intended to help control remedy costs and to promote both consistent and cost-effective decisions. Consistent with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), in addition to being protective, all remedies are to be cost-effective. The Board considers the nature of the site; risks posed by the site; regional, state, tribal and potentially responsible party (PRP) opinions on proposed actions; the quality and reasonableness of the cost

estimates; and any other relevant factors or program guidance in making our advisory recommendations. The overall goal of the review is to ensure sound decision making consistent with current law, regulations, and guidance.

Generally, the Board makes the advisory recommendations to the appropriate regional division director. Then, the region will include these recommendations in the administrative record for the site, typically before it issues the proposed cleanup plan for public comment. While the region is expected to give the Board's recommendations substantial weight, other important factors, such as subsequent public comment or technical analyses of response options, may influence the region's final remedy decision. The Board expects the regional division director to respond in writing to its recommendations within a reasonable period of time, noting in particular how the recommendations influenced the proposed cleanup decision, including any effect on the estimated cost of the action. Although the Board's recommendations are to be given substantial weight, the Board does not change the Agency's current delegations or alter the public's role in site decisions; the region has the final decision-making authority.

Overview of the Proposed Action

The Site is located on the shore of Raritan Bay, in the eastern part of Old Bridge Township within the Laurence Harbor section in Middlesex County, New Jersey; a small portion of the western end of the Site, the western jetty at the Cheesequake Creek Inlet, is located in the Borough of Sayreville. The Site is bordered to the north by Raritan Bay and to the east, west and south by residential properties. Approximately 1.5 miles in length, the Site consists of the waterfront area between Margaret's Creek and the area just beyond the western jetty at the Cheesequake Creek Inlet. The portion of the Site in Laurence Harbor is part of Old Bridge Waterfront Park. The park includes walking paths, a playground area, several public beaches and three jetties, not including the two jetties (western jetty and eastern jetty) at the Cheesequake Creek Inlet. The park waterfront is protected by a seawall, which is partially constructed with pieces of waste slag from a secondary lead smelter. The western jetty at the Cheesequake Creek Inlet and the adjoining waterfront area west of the jetty are located in Sayreville. Slag has been placed on top of the western jetty and is observed along the adjoining waterfront. Slag was also observed in the Margaret's Creek area, an undeveloped 47-acre wetland located southeast of the seawall.

EPA has not divided the Site into operable units. The Agency will select one final remedy to address the entire Site. The remedy will eliminate the slag, battery casings, contaminated soil and sediment as sources of contamination for the Site, with long-term surface water and groundwater monitoring. Such monitoring may include biota collection and/or laboratory studies to evaluate the effectiveness of the remedy.

The Region's proposed action involves removal and/or dredging of slag, battery casing/associated wastes, contaminated soils and sediment above the preliminary remediation goals (PRGs) and off-site disposal, with this material primarily located in the western jetty and the seawall, along with some additional material throughout the Margaret's Creek wetlands area. This action also includes monitored natural recovery (MNR) for the wetlands and sediment areas located to the west of the western jetty.

Other components of the remedy include restoration of the wetlands, and monitoring of media such as groundwater and surface water, along with five-year reviews, until remedial action objectives (RAOs) have been achieved.

National Remedy Review Board Advisory Recommendations

The Board reviewed the information package describing this proposal and discussed related issues with Region 2 management and staff (Walter Mugdan, John LaPadula, Angela Carpenter, Tanya Mitchell, Lora Smith, Michael Scorca and Mindy Pensak) by web conference on March 14, 2012. Based on this review and discussion, the Board offers the following comments:

Institutional Controls

The package presented to the Board did not provide detailed information on the types of institutional controls (ICs) that will be needed under CERCLA to ensure protectiveness of human health with regard to all of the affected media, as well as for fishing and clamming. Nonetheless, the Board notes that there are already bay-wide advisories. The Board encourages the Region to work with the State to consider and address any current and potential future exposures that may occur. The Board recommends that the Region's decision documents provide detailed information on use restrictions and areas requiring controls for both the implementation phase of the remedial action and after completion, if need be. Also, it would be helpful for the decision documents to identify the IC implementation measures and specify the entity(ies) responsible for implementing them.

Human Health and Ecological Risk

In the materials presented to the Board, the Region stated that the ecological risk assessment portion of the remedial investigation was a screening level ecological risk assessment, versus a full baseline ecological risk assessment (BERA), with the addition of several focused ecological risk characterizations. In addition, the Region indicated that a substantial portion of the remedy will be driven by ecological risks. While the Board recognizes that guidance (OSWER Directive No.9285.7-25, July 1997, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*) does not specifically require that a BERA be performed at every site, the guidance recommends that a BERA generally be performed at sites where the remedy is primarily designed to address ecological risk. The Board recommends that the Region either conduct a BERA in support of the remedy or provide an explanation in the decision documents as to why it did not believe carrying out a full BERA was appropriate for the evaluation of alternatives and selection of the remedy.

It was not clear through the presentation to the Board how each of the PRGs were determined (human health, ecologically based risk or both) and whether the proposed clean-up levels were based upon human health risk reduction, ecological risk reduction, both human and ecological risk reduction, or driven by State regulations. Similarly, it was unclear in the presentation how the individual contaminant risks and associated PRGs fit into the Region's rationale for use of a unified PRG approach for both soils and sediments. Given the complexity of issues involved (human and ecological risk, State regulations

and soil-sediment relationships) the Board also recommends that the Region clarify in the decision documents which site-related contaminants and associated risks (human and ecological) are being addressed by the various, specific aspects of the Region's preferred remedy. The Board believes this clarification should help demonstrate how the Region's remedy selection approach ensures protection of human health and the environment, and complies with State applicable or relevant and appropriate requirements (ARARs).

In the presentation to the Board, the Region indicated that, as part of the human health risk assessment, the fish/shellfish arsenic sampling was analyzed for total arsenic and was assumed to be inorganic arsenic. The Board notes that this is a conservative assumption, since the tissue samples were not analyzed for both inorganic and organic arsenic. The Board also notes that at other sites, arsenic speciation in fish tissue has significantly affected the risk conclusions. Since arsenic risk may drive at least a portion of the remedial action and exposure to arsenic via fish consumption appears to be a significant portion of the total arsenic exposure, the Board recommends that the Region explain in its decision documents the assumptions made regarding arsenic speciation within the risk assessment, and how those assumptions affected the evaluation of alternatives and selection of remedial action.

Remedial Action Objectives

The package provided to the Board states that there were two rounds of groundwater sampling, with the second round done to confirm lead results from the first round. The Board is concerned that this sampling approach results in insufficient data on which to base a final groundwater remedial action. The package also states that the RAO for groundwater is to "reduce to acceptable levels the human health risks from the ingestion of groundwater," yet there are no associated PRGs/cleanup levels against which to measure this reduction. The preferred alternative calls for ICs to restrict use of groundwater and long-term monitoring. The Board notes that under the NCP, the remedy selection process under CERCLA is guided by several expectations (see 40 CFR § 300.430(a)(1)(iii)), which include: 1) groundwater should be returned to its beneficial use wherever practicable in a reasonable time frame, and 2) ICs should supplement engineering controls to prevent or limit exposure, but ICs normally "shall not substitute for active response measures" (i.e., ICs are not to be used as the sole remedy unless active response measures are determined to be impracticable). Furthermore, the Agency's long-standing policy (OSWER Directive No. 9355.3-01, October 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, Chapter 4) is that monitoring by itself is not a CERCLA remedial action; the Board is concerned that the information submitted to the Board suggests that monitoring to evaluate effectiveness of the source control remedy may be intended to constitute a final groundwater response action for this site. As such, the Board recommends that the decision documents more clearly explain the role of monitoring in the Region's preferred approach and provide a clear, measurable RAO and associated cleanup level. The Board also suggests that, should one be needed, the Region consider issuing a separate future final groundwater remedial action decision document.

The package provided to the Board states: "Adult anglers and children consuming self-caught fish and hard clam from the Site have cancer risks or noncancer health hazards exceeding EPA's target threshold due to arsenic." In light of this statement, the Board recommends that the Region establish a specific

RAO for this exposure route and develop measurable cleanup levels (concentration limits) for arsenic in specific fish and clams so it is clear when the RAO will be achieved.

Remedy Performance

Based on the package presented to the Board, Alternative 5 would include a sediment cap in Area 8, but it is unclear if the intended purpose of the proposed cap would be as an “active” cap for sequestering lead (such as a reactive core mat design containing apatite) or as an inert sand cap for physical isolation purposes. In light of the CERCLA and NCP preference for remedial actions that utilize treatment technologies to the maximum extent practicable, the Board recommends that the Region explain in its decision documents why it did not further consider a sediment cap (either active or inert). In addition, the Board notes that there are a limited number of *in-situ* treatment technologies (such as soil amendment, solidification/stabilization or mechanical size separation) that could be considered for lead-contaminated soil/sediment in the non-jetty areas of the Site. The Board recommends that the Region better explain in its decision documents why these technologies are not practicable to the maximum extent at this site.

Based on the package provided to the Board, an MNR approach is included as a component of the remedial alternatives. For example, the preferred alternative, as presented in the package, appears to rely on MNR for the wetlands area (including possibly some portions that may be wetland/hydric soil areas). The Board recommends that the Region more clearly explain its proposed use of MNR for the wetland area (e.g., in the hatched area of Figure 38 in the package) and include lines of evidence in the administrative record that support its use. The Board also recommends that the decision documents more clearly explain how the MNR component of the preferred alternative would ensure protectiveness.

Applicable or Relevant and Appropriate Requirements

The Region's presentation to the Board included definitions for wetland soil versus aquatic sediment that were developed for the Raritan Bay site. The Board believes that the definitions for wetland soil and aquatic sediment are critical components for the preferred alternative (#3), which includes excavations, MNR and on-site disposal. The Board recommends that the Region clarify the site-specific soil and sediment definitions and explain their compatibility with other EPA definitions (e.g., http://water.epa.gov/type/wetlands/types_index.cfm) and other agencies' definitions (e.g., Army Corps of Engineers [COE] Wetlands Delineation Manual and Soil Conservation Service's [SCS] definition for hydric soils), as well as the relationship to MNR, and the State of New Jersey's soil standards.

The Board notes that for certain areas of the Site, the Region may be considering the New Jersey soil remediation standards as a potential ARAR. At the same time, it appears that the Region's preferred alternative would consider the wetlands area as a contaminated sediment site and would use an MNR approach for cleanup. Application of the definitions of wetland soil and aquatic sediment could be important for evaluating alternatives and determining the potential use of ARARs and TBCs at this site. In particular, the Board recommends that the Region describe in more detail how various portions of the Site are saturated, flooded or ponded, as described in the EPA/COE/SCS definitions. In light of existing Agency definitions developed for the wetlands program, the Board recommends that the Region more

clearly explain in its decision documents how it is delineating specific areas of soil and sediment throughout the Site, and whether the state soil standards should be considered more appropriately as potential ARARs or TBCs in various locations.

Furthermore, the package presented to the Board indicates in Table 9 that Executive Order 11988 and OSHA 29 CFR 1910 are applicable standards. The Board notes that, while these are important considerations, they do not represent the kind of promulgated, enforceable and generally applicable (or waiveable) regulations or standards that generally qualify as ARARs. The Region should clarify the list of ARARs consistent with Appendix E of OSWER Directive No. 9355.3-01, October 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* and contact OSRTI/ARD/SARDB if it needs assistance.

Finally, in the presentation to the Board, the Region indicated that the final arsenic cleanup level of 15 mg/kg was derived from the site-specific background concentration of arsenic. The Region's justification for using background as the remedial goal was founded in a human health risk characterization that utilized conservative assumptions of arsenic chemical form and toxicity. These conservative assumptions, coupled with State regulations and EPA policy, support the use of background as the clean-up goal when risk-based remedial goals are below background. Given that further evaluation of arsenic risk at this site may suggest that human health arsenic risk is lower than the risks presented, the Board notes that the risk-based sediment arsenic remedy goal may increase to a concentration above background. Since it was unclear in the presentation to the Board whether the State actually has a numeric arsenic standard for sediment that constitutes an ARAR, the Board recommends that the Region better explain in its decision documents whether the State standard for arsenic is an ARAR or TBC, and how this could affect the remedy.

Cost

According to the information presented to the Board, the discount rate used for the net present worth cost calculations of remedial alternatives was 5.25 percent. However, the Board notes that, in accordance with current EPA guidance, OSWER Directive 9355.0-75 (July 2000; pages 4-4 and 4-5), a discount rate of 7 percent should generally be used for all non-Federal facility feasibility study present-value analysis. Therefore, the Board recommends that the Region either: (1) use a discount rate of 7 percent for all present worth calculations, or (2) provide an explanation and sensitivity analysis in accordance with the above-noted 2000 EPA guidance. In addition, it is noted in the cost information presented to the Board that an escalation factor of 3.11 percent was also used in the present value cost analysis for all remedial alternatives. The Board recommends that the Region provide further explanation in the decision documents for the use of this escalation factor. Finally, in the cost summary information presented to the Board (page 39 of the package), it appears that non-discounted operation and maintenance costs were used in the calculation of what is referred to as "present worth costs." While the OSWER guidance referenced above recommends the development of a non-discounted scenario (page 4-2), it also states that the non-discounted scenario should be presented for comparison purposes only, and should not be used in place of present value costs in the remedy selection process. The Board recommends that the Region review the present worth analysis for each of the alternatives to ensure that the appropriate values were used in the development of total present worth costs. Future decision

documents should include present worth values calculated using 7 percent and may include present worth values using a different discount rate provided a specific explanation is given.

In the package and presentation to the Board, it was noted that remedial alternatives #3-6 all meet, to varying degrees, the NCP comparative analysis of alternatives criteria. It was also noted that the preferred alternative (#3) was approximately \$30M more than alternatives #4 or #5; this additional expense results from the Region's preference to excavate/dredge and dispose offsite all of the contaminated slag, battery casings, and soil and sediment (excluding areas 7, 9, and 11). Further, the Region indicated that the contaminated slag and battery casings mainly constitute the Site's principal threat waste (PTW). The Board commends the Region for PTW removal and disposal-treatment at this site; however, it is unclear why the remaining, lesser-contaminated soil and sediment cannot be adequately contained on-site at a lower overall cost while still ensuring protectiveness of human health, consistent with the NCP's nine criteria for evaluating alternatives. Given this lack of clarity, the Board recommends that the Region more clearly explain in the decision documents its reasons for preferring a more costly remedy over other alternatives that are also protective at this site.

Preliminary Remediation Goals/Cleanup Levels

During the presentation to the Board, the Region indicated that as a result of some recent re-analysis, the unified lead PRG may be established as 400 mg/kg rather than the value of 232 mg/kg, the value presented in the review package. The Board also notes that comments provided on behalf of NL Industries, Inc., by Advanced Geoservices Corporation dated March 12, 2012, raised issues with regard to both the proposed PRGs and the use of the unified PRG approach at this site. The Board recommends that the Region, in its decision documents, better explain the basis for the selection of each of the compound-specific PRGs and its rationale for the use of the unified PRG approach.

The Board notes that the package states that long term-monitoring would include biota sampling; the Board recommends that the Region's decision documents include cleanup levels against which sampling results will be compared.

Conclusion

We commend the Region's collaborative efforts in working with the Board and stakeholder groups at this site. We request that a draft response to these recommendations be included with the draft proposed plan when it is forwarded to the Office of Superfund Remediation and Technology Innovation's Site Assessment and Remedy Decisions (SARD) branch for review. The SARD branch will work with both your staff and the Board to resolve any remaining issues prior to your release of the record of decision. This memo will be posted to the Board's website (<http://www.epa.gov/superfund/programs/nrrb>) within 30 calendar days of my signature. Once your response is final and made part of the Site's administrative record, your response will also be posted on the Board's website.

Thank you for your support and the support of your managers and staff in preparing for this review.
Please call me at (703) 347-0124 should you have any questions.

cc: J. Woolford (OSRTI)
P. Anderson (OSRTI)
E. Gilberg (OSRE)
R. Cheatham (FFRRO)
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NRRB members

Exh. 0.

Exhibit O



A Guide to Principal Threat and Low Level Threat Wastes

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) promulgated on March 8, 1990 states that EPA expects to use "treatment to address the principal threats posed by a site, wherever practicable" and "engineering controls, such as containment, for waste that poses a relatively low long-term threat." (40 CFR Section 300.430(a)(1)(iii).) These expectations, derived from the mandates of CERCLA §121 and based on previous Superfund experience, were developed as guidelines to communicate the types of remedies that the EPA generally anticipates to find appropriate for specific types of wastes. Although remedy selection decisions are ultimately site-specific determinations based on an analysis of remedial alternatives using the nine evaluation criteria, these expectations help to streamline and focus the remedial investigation/feasibility study (RI/FS) on appropriate waste management options. This guide explains considerations that should be taken into account in categorizing waste for which treatment or containment generally will be suitable and provides definitions, examples, and ROD documentation requirements related to waste that constitute a principal or low level threat. EPA makes this categorization of waste as principal or low level threat waste after deciding whether to take remedial action at a site. The "Interim Final Guidance on Preparing Superfund Decision Documents," (EPA/624/1-87/90, October 1990) and "A Guide to Developing Superfund Records of Decision" (Publication 9335.3-02FS-1, May 1990) provide additional information on ROD documentation.

NCP Expectations

EPA established general expectations in the NCP (40 CFR 300.430(a)(1)(iii)) to inform the public of the types of remedies that EPA has found to be appropriate for certain types of waste in the past and anticipates selecting in the future. These expectations (see Highlight 1) provide a means of sharing collected experience to guide the development of cleanup options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur. Conversely, these expectations also reflect the fact that other source materials can be safely contained and that treatment for all waste will not be appropriate or necessary to ensure protection of human health and the environment, nor cost effective.

Identifying Principal and Low Level Threat Wastes

The concept of principal threat waste and low level threat waste as developed by EPA in the NCP is to be applied on a site-specific basis when characterizing source material. "Source material" is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for direct exposure.

HIGHLIGHT 1: NCP Expectations Involving Principal and Low Level Threat Wastes

EPA expects to:

1. Use treatment to address the principal threats posed by a site, wherever practicable.
2. Use engineering controls, such as containment, for wastes that pose a relatively low long-term threat or where treatment is impracticable.
3. Use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls (such as containment) and institutional controls, as appropriate, for treatment residuals and untreated waste.
4. Use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances.



Contaminated ground water generally is not considered to be a source material although non-aqueous phase liquids (NAPLs) may be viewed as source materials. The NCP establishes a different expectation for remediating contaminated ground water (i.e., to return usable ground waters to their beneficial uses in a time frame that is reasonable given the particular circumstances of the site). Examples of source and non-source materials are provided in Highlight 2.

HIGHLIGHT 2: Examples of Source and Non-Source Materials

Source Materials

- Drummed wastes
- Contaminated soil and debris
- "Pools" of dense non-aqueous phase liquids (NAPLs) submerged beneath ground water or in fractured bedrock
- NAPLs floating on ground water
- Contaminated sediments and sludges

Non-Source Materials

- Ground water
- Surface water
- Residuals resulting from treatment of site materials

Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated.

Low level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of release. They include source materials that exhibit low toxicity, low mobility in the environment, or are near health-based levels.

Determinations as to whether a source material is a principal or low level threat waste should be based on the inherent toxicity as well as a consideration of the physical state of the material (e.g., liquid), the potential mobility of the wastes in the particular environmental setting, and the lability and degradation products of the material. However, this concept of principal and low level threat waste should not necessarily be equated with the risks posed by site contaminants via various exposure pathways. Although the characterization of some material as principal or low level threats takes into account toxicity (and is thus related to degree of risk posed assuming exposure occurs), characterizing a waste as a principal threat does not mean that the waste poses the primary risk at the site. For example, buried drums leaking

solvents into ground water would be considered a principal threat waste, yet the primary risk at the site (assuming little or no direct contact threat) could be ingestion of contaminated ground water, which as discussed above is not considered to be a source material, and thus would not be categorized as a principal threat.

The identification of principal and low level threats is made on a site-specific basis. In some situations site wastes will not be readily classifiable as either a principal or low level threat waste, and thus no general expectations on how best to manage these source materials of moderate toxicity and mobility will necessarily apply. [NOTE: In these situations wastes do not have to be characterized as either one or the other. The principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement.]

HIGHLIGHT 3: Examples of Principal and Low Level Threat Wastes

Wastes that generally will be considered to constitute principal threats include, but are not limited to:

- **Liquids** - waste contained in drums, lagoons or tanks, free product (NAPLs) floating on or under ground water (generally excluding ground water) containing contaminants of concern.
- **Mobile source material** - surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or sub-surface transport.
- **Highly-toxic source material** - buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials.

Waste that generally will be considered to constitute low level threat wastes include, but are not limited to:

- **Non-mobile contaminated source material of low to moderate toxicity** - Surface soil containing contaminants of concern that generally are relatively immobile in air or ground water (i.e., non-liquid, low volatility, low leachability contaminants such as high molecular weight compounds) in the specific environmental setting.
- **Low toxicity source material** - soil and subsurface soil concentrations not greatly above reference dose levels or that present an excess cancer risk near the acceptable risk range.

Examples of principal and low level threat wastes are provided in Highlight 3.

Risk Management Decisions for Principal and Low Level Threat Wastes

The categorization of source material as a principal threat or low level threat waste, and the expectations regarding the use of treatment and containment technologies follows the fundamental decision as to whether any remedial action is required at a site. These determinations, and the application of the expectations, serve as general guidelines and do not dictate the selection of a particular remedial alternative. For example, EPA's experience has demonstrated that highly mobile wastes (e.g., liquids) are difficult to reliably contain and thus generally need to be treated. As such, EPA expects alternatives developed to address highly mobile material to focus on treatment options rather than containment approaches.

However, as stated in the preamble to the NCP (55 FR at 8703, March 8, 1990), there may be situations where wastes identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the wastes. Specific situations that may limit the use of treatment include:

- Treatment technologies are not technically feasible or are not available within a reasonable time frame;
- The extraordinary volume of materials or complexity of the site make implementation of treatment technologies impracticable;
- Implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to risks posed to workers or the surrounding community during implementation; or
- Severe effects across environmental media resulting from implementation would occur.

Conversely, there may be situations where treatment will be selected for both principal threat wastes and low level threat wastes. For example, once a decision has been made to treat some wastes (e.g., in an onsite incinerator) economies of scale may make it cost effective to treat all materials including low level threat wastes to alleviate or minimize the need for engineering/institutional controls.

While these expectations may guide the development of appropriate alternatives, the fact that a remedy is consistent with the expectations does not constitute sufficient grounds for the selection of that remedial alternative. The selection of an appropriate waste management strategy is determined solely through the remedy selection process outlined in the NCP (i.e.,

all remedy selection decisions are site-specific and must be based on a comparative analysis of the alternatives using the nine criteria in accordance with the NCP). Independent of the expectations, selected remedies must be protective, ARAR-compliant, cost-effective, and use permanent solutions or treatment to the maximum extent practicable. Once the final remedy is selected, consistency with the NCP expectations should be discussed as part of the documented rationale for the decision.

ROD Documentation

Declaration

The "Description of the Selected Remedy" section should note whether the remedy is addressing any source materials that constitute "principal" or "low level" threat wastes, or both.

The "Statutory Determinations" section should discuss how the selected remedy satisfies the statutory preference stated in CERCLA §121 to select remedial actions "in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element." In evaluating this statutory preference, the site manager needs to decide whether treatment selected in the ROD constitutes treatment as a major component of the remedy for that site. Remedies which involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element, although this will not necessarily be true in all cases (e.g., when principal threat wastes that are treated represent only a small fraction of the wastes managed through containment). Ground water treatment remedies also may satisfy the statutory preference, even though contaminated ground water is not considered a principal threat waste and even though principal threat source material may not be treated.

Decision Summary

The "Decision Summary" of the ROD should identify those source materials that have been identified as principal threat and/or low level threat wastes, and the basis for these designations. These designations should be provided in the "Summary of Site Characteristics" section as part of the discussion focusing on these source materials that pose or potentially pose a risk to human health and the environment. In addition, the "Description of Alternatives" and the "Selection of Remedy" sections should briefly note how principal and/or low level threat wastes that may have been identified are being managed.

The "Statutory Determinations" section of the ROD should include a discussion of how the statutory preference for treatment as a principal element is satisfied or explain why it is not satisfied, stating reasons in terms of the nine evaluation criteria.

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.



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EPA 540-R-97-013
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PB97-963301
August 1997

Superfund



RULES OF THUMB FOR SUPERFUND REMEDY SELECTION



EPA 540-R-97-013
OSWER 9355.0-69
PB97-963301
August 1997

RULES OF THUMB FOR SUPERFUND REMEDY SELECTION

**Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460**

Notice: This document provides guidance to EPA staff. It also provides guidance to the public and to the regulated community on how EPA intends to exercise its discretion in implementing the National Contingency Plan. The guidance is designed to communicate national policy on these issues. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future, as appropriate.

ABSTRACT

This guidance document describes key principles and expectations, interspersed with "best practices" based on program experience, that should be consulted during the Superfund remedy selection process. These remedy selection "Rules of Thumb" are organized into three major policy areas: 1) risk assessment and risk management, 2) developing remedial alternatives, and 3) ground-water response actions. The purpose of this guide is to briefly summarize key elements of various remedy selection guidance documents and policies in one publication. EPA believes that consistent application of national policy and guidance is an important means by which we ensure the reasonableness, predictability, and cost-effectiveness of our decisions. Gathering these remedy selection policy expectations into one document will support our ongoing efforts to promote these important objectives. For more detailed discussions of these policy areas, consult the National Contingency Plan (NCP) and the guidance documents listed at the end of each section. This guide has been developed as one of the Superfund administrative reforms announced by Administrator Carol Browner on October 2, 1995.



To Obtain Documents:

EPA employees can obtain additional copies of this guidance, or copies of documents referenced in this guidance, by calling the Superfund Document Center at 703-603-9232, or by sending an e-mail request to superfund.documentcenter@epamail.gov. Non-EPA employees can obtain these documents by contacting the National Technical Information Service at 703-487-4650. This document is also available on the Internet at <http://www.epa.gov/superfund>.

INTRODUCTION

The Superfund program's remedy selection process links the analysis of site cleanup alternatives, conducted in a remedial investigation/feasibility study (RI/FS), with the documentation of the selected remedy in a Record of Decision (ROD). Section 121 of the Superfund statute (the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)) established five principal requirements for the selection of remedies. Remedies must: 1) protect human health and the environment; 2) comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy a preference for treatment as a principal element, or provide an explanation in the ROD as to why this preference was not met.

In the Superfund regulations (the National Oil and Hazardous Substances Contingency Plan (NCP)), EPA established a national goal and a series of expectations to reflect the principal requirements of Section 121 and to help focus the RI/FS on appropriate waste management options (Exhibit 1). EPA also developed nine criteria for evaluating remedial alternatives to ensure that all important considerations are factored into remedy selection decisions (Exhibit 2). These criteria are derived from the statutory requirements of Section 121, as well as technical and policy considerations that have proven to be important for selecting among remedial alternatives. The nine criteria analysis comprises two steps: an individual evaluation of each alternative with respect to each criterion; and a comparison of options to determine the relative performance of the alternatives and identify major trade-offs among them (i.e., relative advantages and disadvantages).



Applicability to the RCRA Corrective Action Program

The Superfund and Resource Conservation and Recovery Act (RCRA) Corrective Action programs generally should yield similar remedies in similar circumstances. Therefore, the Agency believes that many of the principles conveyed in this document are applicable to the RCRA Corrective Action program, except where justified based on clear programmatic differences. For example, although RCRA Corrective Action incorporates risk-based decision making, formal "baseline risk assessments" are not always conducted as they are for Superfund sites. Superfund project managers using these principles can be confident that remedies selected generally will satisfy RCRA Corrective Action; likewise, RCRA Corrective Action project managers are encouraged to use these principles, as appropriate, to promote cost-effective remedial decision making and consistency with Superfund. For more information see: *Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities* (OSWER Directive 9200.0-25, September 24, 1996); and *Advance Notice of Proposed Rulemaking (ANPR) for RCRA Corrective Action* (61 FR 19432, May 1, 1996).

Exhibit 1

Superfund Program Goal and Expectations

Program Goal (40 CFR 300.430(a)(1)(i))

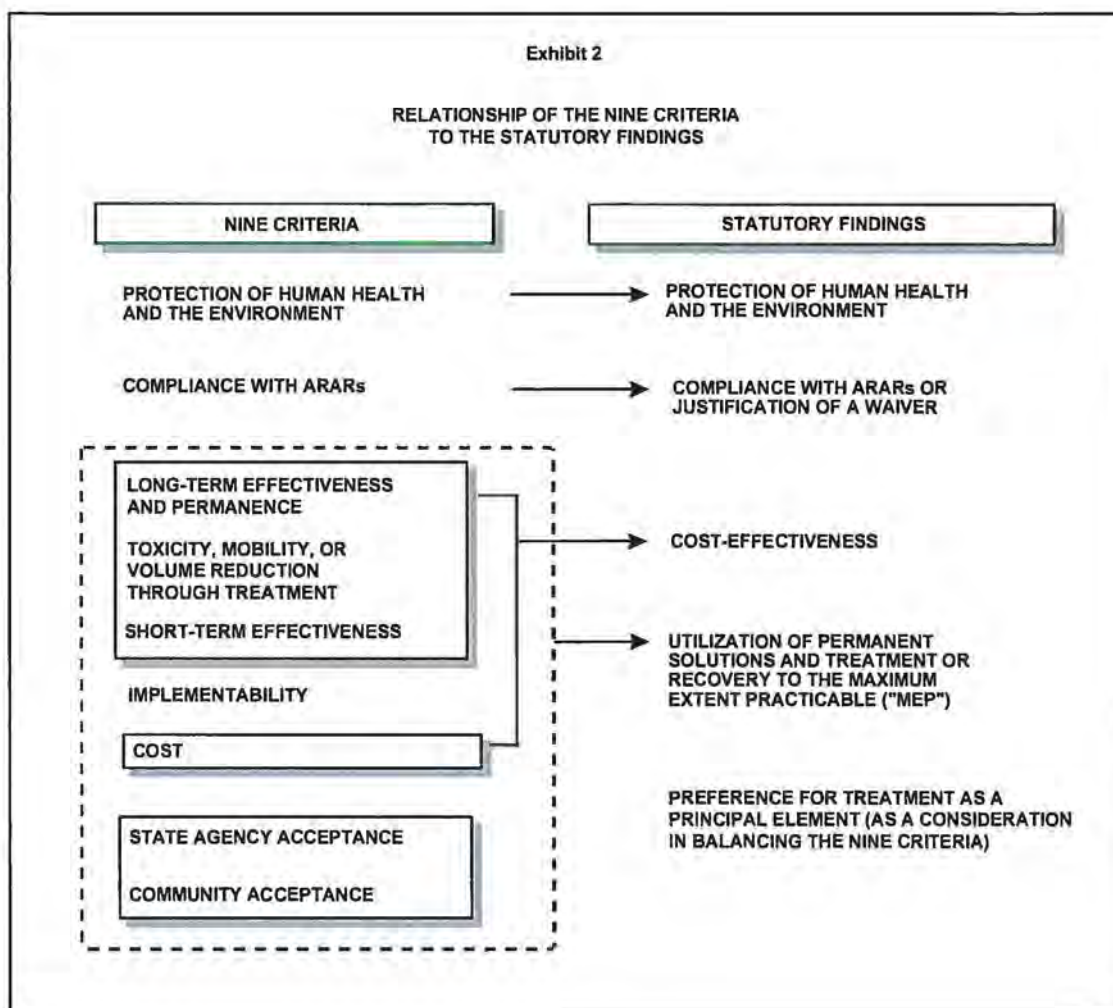
The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste.

Program Expectations (40 CFR 300.430(a)(1)(iii)(A-F))

EPA generally shall consider the following expectations in developing appropriate remedial alternatives:

- EPA expects to use treatment to address the principal threats posed by a site, wherever practicable.
- EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable.
- EPA expects to use a combination of methods, as appropriate, to achieve protection of human health and the environment.
- EPA expects to use institutional controls, such as water use and deed restrictions, to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants or contaminants.
- EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.
- EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

EPA established the RI/FS process for gathering the information necessary to select a remedy that is appropriate for the site and fulfills these statutory mandates. The RI includes sampling and analysis to characterize the nature and extent of site contamination, performance of a baseline risk assessment to assess the current and potential future risks to human health and the environment posed by that contamination, and the conduct of treatability studies (where appropriate) to evaluate the potential costs and effectiveness of treatment (or recovery) technologies to reduce the toxicity, mobility, or volume of specific site waste. The FS includes the development and screening of alternative remedial actions, and the detailed evaluation and comparison of the final candidate cleanup options. Typically, a range of options is developed during the FS concurrently with the RI site characterization, with the results of each influencing the other in an iterative fashion. (See *RI/FS Guidance* for a more complete discussion.)



EPA also established a two-step remedy selection process, in which a preferred remedial action is presented to the public for comment in a Proposed Plan, which summarizes preliminary conclusions as to why that option appears most favorable based on the information available and considered during the FS. Following receipt and evaluation of public comments on the Proposed Plan (which may include new information), EPA makes a final decision and documents the selected remedy in a ROD. (See *Remedy Selection Guidance* for a more complete discussion.)

EPA has issued numerous guidance documents that complement and clarify the remedy selection framework presented in the NCP. *Rules of Thumb for Superfund Remedy Selection* summarizes the remedy selection policy expectations contained in these guidance documents as well as in the Superfund statute and regulations. By summarizing this information in a single document, EPA expects to assist Remedial Project Managers and other program implementers in applying remedy selection principles in an appropriately consistent manner.





Please note that this guidance document is not a comprehensive guide to every Agency policy that might affect remedy selection, nor is it a replacement for the careful application of regulatory and statutory requirements to individual sites. Rather, the document is a synopsis of the principles and

expectations that are likely to have the most bearing on a wide range of site remedy selections. While this document should help expedite and focus the remedy selection process, it is not a substitute for a careful review and application of CERCLA, the NCP, and relevant guidance documents at individual sites.

Primary source documents for policy statements have been identified in parentheses in italics following each Rule of Thumb and full citations are included at the end of each major section. Specific page citations are provided, where appropriate, and represent the beginning of a relevant section in the document. These source documents should be obtained and consulted for more information.



For Additional Information on the Remedy Selection Process:

-  **NCP:** *National Oil and Hazardous Substances Pollution Contingency Plan (The NCP): With the Preambles of 1988 and 1990 and the New Index of Key Terms* (OSWER Publication 9200.2-14, January 1992).
-  **RI/FS Guidance:** *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 540-G-89-004, October 1988).
-  **ROD Guidance:** *Interim Final Guidance on Preparing Superfund Decision Documents: The Proposed Plan, The Record of Decision, Explanation of Significant Differences, The Record of Decision Amendment: Interim Final* (EPA 540-G-89-007, July 1989). (Revision anticipated in 1998.)
-  **Remedy Selection Guidance:** *A Guide to Selecting Superfund Remedial Actions* (OSWER Publication 9355.0-27FS, April 1990).
-  **SACM Guidance:** *Guidance on Implementation of the Superfund Accelerated Cleanup Model (SACM) under CERCLA and the NCP* (OSWER Directive 9203.1-03, July 7, 1992). Five additional fact sheets also describe SACM and are available by citing the following reference: OSWER Directive 9203.1-05I (Volume 1, Numbers 1-5), December 1992.
-  **Non-Time Critical Removal Guidance:** *Guidance on Conducting Non-Time Critical Removal Actions under CERCLA* (EPA 540-R-93-057, August 1993).
-  **Role of Cost Directive:** *The Role of Cost in the Superfund Remedy Selection Process* (EPA 540-F-96-018, September 1996).

RISK ASSESSMENT AND RISK MANAGEMENT

Background

The mandate of the Superfund program is to protect human health and the environment from current and potential threats posed by uncontrolled hazardous waste sites. The NCP established the RI/FS process to characterize the nature and extent of site risks, develop and evaluate cleanup options, and gather other information necessary to select a remedy that is appropriate for a site. A baseline risk assessment is performed as part of the RI/FS to evaluate the potential threat to human health and the environment in the absence of any remedial action. EPA uses the results of the RI/FS and baseline risk assessment to make a series of site-specific risk management decisions in the Superfund remedy selection process.

Presented below is a summary of key principles and expectations for risk assessment and risk management that have been developed for the Superfund program. Consideration of these principles will help ensure that remedies are both cost-effective and appropriately consistent with national policy and guidance.

Risk Assessment Rules of Thumb

The following principles should be consulted when developing the baseline risk assessment. If the RI/FS only addresses a portion of the site or specific medium (e.g., ground water), these principles apply to the baseline risk assessment developed in support of that specific operable unit. Additional efforts may be required to relate the specific action to the overall risk posed by the site as a whole.

- 1) **Conceptual Site Model:** Evaluate available data and develop a well-defined conceptual site model (CSM) in the earliest stages of the baseline risk assessment. The CSM is a three-dimensional "picture" of site conditions that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential human and ecological receptors. The CSM documents current and potential future site conditions and is supported by maps, cross sections, and site diagrams that illustrate what is known about human and environmental exposure through contaminant release and migration to potential receptors. The CSM is initially developed during the scoping phase of the RI/FS and should be modified as additional information becomes available. (*RI/FS Guidance; DQO Guidance; Soil Screening Guidance; and RAGS I Part A*)
- 2) **Exposure Pathways:** Evaluate all relevant exposure pathways related to the site (e.g., direct ingestion, inhalation), for both current and reasonably anticipated future land uses as well as current and potential future ground-water and surface water uses. (*Land Use Directive; RAGS I Part A; and Soil Screening Level Guidance*)
- 3) **Data Needs:** Collect sufficient contaminant concentration data from each relevant medium

to adequately characterize the nature and extent of contamination and to develop sound estimates of risk associated with each exposure pathway. (*DQO Guidance*)

4) **Site-Specific Risk Calculation:** The following principles apply to site-specific risk calculations in the baseline risk assessment:

- Calculate the cumulative risks to an individual for chronic exposures, using reasonable maximum exposure (RME) assumptions by combining a statistically sound, arithmetic average, exposure-point concentration with reasonably conservative values for intake and duration. The most current updates on exposure assumptions, methods, and models for the residential exposure scenario can be obtained from the *Soil Screening Guidance*.
- Use the most current toxicity values provided by the Integrated Risk Information System (IRIS) or the Health Effects Assessment Summary Tables (HEAST). Call the Superfund Technical Support Center in Cincinnati at (513) 569-7300 if toxicity values are not reported in IRIS or HEAST. (*RAGS I Part A*)
- Include estimates of risk for current and reasonably anticipated future land uses and potential future ground-water and surface water uses, without institutional controls. The baseline risk assessment is essentially an evaluation of the "no action" alternative (i.e., an assessment of the risk associated with a site in the absence of any remedial action or control). While institutional controls do not actively clean up the contamination at a site, they can control exposure and, therefore, are considered to be limited action alternatives that may be evaluated during the remedy selection process. (*1990 NCP Preamble at 55 FR 8710*)
- Include a discussion that identifies major sources of uncertainty or variability and their influence on the risk estimates. Probabilistic methods may aid in evaluating uncertainty at some sites. (*RAGS I Part A; and EPA's Risk Characterization Policy*)

5) **Other Measures of Risk:** Other measures of risk (e.g., central tendency) can be used to describe site risks more fully. However, RME risk generally should be the principal basis for evaluating potential risks at Superfund sites. (*1990 NCP Preamble at 55 FR 8711; RAGS I Part A, page 6-4; and EPA's Risk Characterization Policy*)

6) **Exposed Populations:** The risk analysis should clearly identify the population, or population sub-group (e.g., highly exposed or susceptible individuals), for which risks are being

evaluated. (*RAGS I Part A, page 6-6; and EPA's Risk Characterization Policy*)

- 7) **Ecological Risk Assessment:** Include an assessment of ecological risk in the baseline risk assessment in order to support EPA's mission to protect the environment. A screening ecological risk assessment generally should be conducted to identify those chemicals, media, and portions of the site requiring more detailed study and analysis. Use site-specific toxicity tests, field studies, and food-chain models whenever appropriate. (*ECO Risk Guidance; and RAGS II*)

Risk Management Rules of Thumb

The following principles should be consulted when making risk management decisions in the Superfund program. Unless otherwise noted, the Rules of Thumb presented in this section are derived from the *Role of Baseline Risk Assessment Directive*.

- 1) **Basis for Action:** A response action is generally warranted if one or more of the following conditions is met:
 - The cumulative excess carcinogenic risk to an individual exceeds 10^{-4} (using reasonable maximum exposure assumptions for either the current or reasonably anticipated future land use);
 - The non-carcinogenic hazard index is greater than one (using reasonable maximum exposure assumptions for either the current or reasonably anticipated future land use);
 - Site contaminants cause adverse environmental impacts; or
 - Chemical-specific standards or other measures that define acceptable risk levels are exceeded and exposure to contaminants above these acceptable levels is predicted for the RME. Examples include: drinking water standards that are exceeded in ground water when that ground water is a current or potential source of drinking water; or water quality standards that are exceeded in surface or ground waters that support the designated uses of these waters (e.g., support aquatic life).

- 2) **Preliminary Remediation Goals for Carcinogens:** In the absence of ARARs for chemicals that pose carcinogenic risks, PRGs generally should be established at concentrations that achieve 10^{-6} excess cancer risk, modifying as appropriate based on exposure, uncertainty, and technical feasibility factors.
- 3) **Preliminary Remediation Goals for Non-Carcinogens:** In the absence of ARARs for chemicals that pose non-carcinogenic risks, PRGs generally should be established at concentrations that achieve a hazard quotient of one. Cumulative noncancer risks are determined by adding hazard quotients for chemicals with the same toxic endpoint or mechanism of action (e.g., the toxic endpoint for both ethylbenzene and styrene is liver toxicity and so these hazard quotients can be summed). In establishing PRGs for chemicals that affect the same target organ/system, PRGs for individual chemicals should be divided by the number of chemicals present in this group (*Soil Screening Guidance*, page 32).
- 4) **Chemical-Specific ARARs:** When a single ARAR for a specific chemical (or in some cases a group of chemicals) defines an acceptable level of exposure, compliance with the ARAR generally will be considered protective even if it is outside the risk range (unless there are extenuating circumstances, such as exposure to multiple contaminants or pathways).
- 5) **Background Concentrations:** EPA does not generally clean up below natural background levels. However, where anthropogenic (i.e., man-made) background levels exceed acceptable risk-based levels, and EPA has determined that a response action is appropriate, EPA's goal is to develop a comprehensive response to address area-wide contamination. This will help avoid response actions that create "clean islands" amid widespread contamination (*Soil Screening Guidance*, page 8).
- 6) **Selecting Remedial Action:** In the absence of ARARs, remedies should reduce the risks



RAOs, PRGs and Final Cleanup Levels














Remedial action objectives (RAOs) provide a general description of what the cleanup will accomplish (e.g., restoration of groundwater). Preliminary remediation goals (PRGs) are the more specific statements of the desired endpoint concentrations or risk levels, for each exposure route, that are believed to provide adequate protection of human health and the environment based on preliminary site information. Initial PRGs are developed early in the RI/FS process and are based on ARARs and other readily available information, such as concentrations associated with 10^{-6} cancer risk or a hazard quotient equal to one for noncarcinogens calculated from EPA toxicity information. Initial PRGs may also be modified based on exposure, uncertainty, and technical feasibility factors. As data are gathered during the baseline risk assessment and RI/FS, PRGs are refined into final contaminant-specific cleanup levels. Based on consideration of factors during the nine criteria analysis and using the PRG as a point of departure, the final cleanup level may reflect a different risk level within the acceptable risk range (10^{-4} to 10^{-6} for carcinogens) than the originally identified PRG. The final cleanup levels, not PRGs, are documented in the Record of Decision.

from carcinogenic contaminants such that the excess cumulative individual lifetime cancer risk for site-related exposures falls between 10^{-4} and 10^{-6} . The Agency has expressed a preference for cleanups achieving the more protective end of the risk range (i.e., 10^{-6}). (NOTE: The upper boundary of the risk range is not a discrete line at 1×10^{-4} , although EPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions.) For non-carcinogens, remedies generally should reduce contaminant concentrations such that exposed populations or sensitive sub-populations will not experience adverse effects during all or part of a lifetime, incorporating an adequate margin of safety (i.e., a hazard index at or below one).

- 7) **Timing:** A "phased approach" to site investigation and cleanup generally will accelerate risk reduction and provide additional technical site information on which to base long-term risk management decisions. Phased cleanup approaches should be employed wherever practicable (40 CFR 300.430(a)(1)(ii)(A)). For more information about the use of early actions to expedite site cleanup, see *SACM Guidance* and the *Ground-Water Presumptive Strategy*.



For Additional Information on Risk Assessment and Risk Management:

-  RI/FS Guidance: *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 540-G-89-004, October 1988).
-  RAGS I Part A: *Risk Assessment Guidance For Superfund, Volume I, Part A: Human Health Evaluation Manual, Interim Final* (EPA 540-I-89-002, March 1989).
-  RAGS II: *Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final* (EPA 540-I-89-001, March 1989).
-  RAGS I Part B: *Risk Assessment Guidance for Superfund, Volume I, Part B: Human Health Evaluation Manual, Development of Risk-Based Preliminary Remediation Goals, Interim Final* (EPA 540-I-89-002, December 1991). [Note: *Soil Screening Guidance* provides improvements in inhalation and ground water exposure pathway discussions.]
-  RAGS I Part C: *Risk Assessment Guidance for Superfund, Volume I, Part C: Human Health Evaluation Manual, Risk Evaluation of Remedial Alternatives, Interim* (EPA 540-R-92-004, December 1991).
-  Role of Baseline Risk Assessment Directive: *Role of the Baseline Risk Assessment in Superfund Remedy Selection* (OSWER Directive 9355.0-30, April 22, 1991).
-  SACM Guidance: *Guidance on Implementation of the Superfund Accelerated Cleanup Model (SACM) under CERCLA and the NCP* (OSWER Directive 9203.1-03, July 7, 1992).
-  DOO Guidance: *Data Quality Objectives Process for Superfund: Interim Final Guidance* (EPA 540-R-93-071, 1993).
-  EPA's Risk Characterization Policy: *Policy for Risk Characterization at the U.S. Environmental Protection Agency* (Memorandum from Administrator Carol Browner, March 21, 1995).
-  Land Use Directive: *Land Use in the CERCLA Remedy Selection Process* (OSWER Directive 9355.7-04, May 25, 1995).
-  Soil Screening Guidance: *Soil Screening Guidance: Users Guide* (EPA 540-R-96-018, April 1996).
-  Ground-Water Presumptive Strategy: *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites* (EPA 540-R-96-023, October 1996).
-  ECO Risk Guidance: *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 540-R-97-006, June 1997).

DEVELOPING REMEDIAL ALTERNATIVES

Background

The national goal of the remedy selection process is to "select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste" (40 CFR 300.430(a)(1)(i)). While protection of human health and the environment can be achieved through a variety of methods, this goal reflects CERCLA's emphasis on achieving protection through the aggressive, but realistic, use of treatment. Remedies that rely on engineering and institutional controls as a major component, in addition to being less permanent than treatment remedies, may place constraints on the productive re-use of land.

To accomplish this goal, the NCP describes six expectations for the development of remedial alternatives. These expectations, derived from the mandates of CERCLA Section 121 and based on previous Superfund experience, were developed as guidelines to communicate the types of remedies that EPA generally will find appropriate for specific types of waste. Although remedy selection decisions are site-specific determinations based on analyses of remedial alternatives using the nine evaluation criteria, these expectations help to focus the RI/FS on appropriate waste management options. This section discusses the first four of the six NCP expectations presented in Exhibit 1. Unless otherwise noted, this section has been derived from the *Principal Threats Guidance*.

Identifying Principal and Low-level Threat Wastes

The concept of principal threat waste and low-level threat waste, as developed by EPA in the NCP and expanded in subsequent guidance, should be applied on a site-specific basis when characterizing "source material." Source material is defined as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for direct exposure.



Reasonably Anticipated Future Land Use and Principal Threat Waste Identification

The reasonably anticipated future land use at a site is significant in defining principal threat waste areas. Pursuant to the NCP and the 1995 land use guidance, current land use and reasonably anticipated future land use should be considered in identifying realistic exposure scenarios for estimating site risks. When the baseline risks associated with the reasonably anticipated future land use trigger action, the definition of principal threat wastes may be determined by the reasonably anticipated future land use scenario as well. For example, soil contamination that could be considered a principal threat under a residential exposure scenario might be considered a low-level threat under a non-residential exposure scenario. Although no "threshold level" of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios. (For more information, see *Principal Threats Guidance* and *Land Use Directive*.)

Contaminated ground-water plumes are generally not considered to be source material, although nonaqueous phase liquids (NAPLs) in the ground water generally would be viewed as source material.

Identifying principal and low-level threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, low-level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

Rules of Thumb for Developing Appropriate Remedial Alternatives for Source Materials

- 1) **Combination of Methods of Protection:** An appropriate combination of treatment technologies, engineering controls, and institutional controls should be considered when developing remediation approaches that will be protective of human health and the environment. Federal or state ARARs (e.g., land disposal restrictions under RCRA) may limit containment and treatment options.
- 2) **Treatment of Principal Threats:** "EPA expects to use treatment to address the principal threats posed by a site, wherever practicable" (*40 CFR 300.430(a)(1)(iii)(A)*).
- 3) **Containment of Principal Threats:** In some situations, it may be appropriate to contain rather than treat principal threat wastes due to difficulties in treating the wastes. The following situations generally should result in a determination that treatment is not practicable under the nine remedy selection criteria (Exhibit 2). For example, when:
 - Treatment technologies are not technically feasible or are not available within a reasonable time frame;
 - The extraordinary volume of materials or complexity of the site may make implementation of the treatment technologies impracticable (e.g., large landfills);
 - Implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to risks posed to workers, the surrounding community, or impacted ecosystems during implementation (to the degree that these risks cannot be otherwise addressed through implementation measures); and
 - Implementation of the treatment technology would have severe effects

across environmental media.

- 4) **Containment of Low Level Threats:** "EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable" (40 CFR 300.430(a)(1)(iii)(B)).
- 5) **Treatment of Low-Level Threats:** In some situations, it may be appropriate to treat rather than contain low-level threat wastes. For example:
 - Once a decision has been made to treat some wastes onsite, economies of scale may make it cost-effective to treat more than just principal threat wastes, to alleviate or minimize the need to maintain engineering or institutional controls over time.
 - In some circumstances, treatment of more than principal threat wastes may be appropriate in order to make the whole site consistent with the reasonably anticipated future land use (e.g., where there are plans for residential development). See the *Land Use Directive* to obtain additional information for considering land use in remedy selection decisions.
- 6) **NAPLs as Principal Threat Wastes:** Although nonaqueous phase liquids (NAPLs) are generally viewed as principal threat wastes, program experience has shown that removal and/or in-situ treatment of NAPLs may not be practicable. Hence, EPA generally expects that the quantity of free-phase NAPL (i.e., "free product") should be reduced to the extent practicable and that an appropriately designed containment strategy should be developed for NAPLs that cannot be removed from the subsurface. This policy applies to both dense nonaqueous phase liquids (DNAPLs) and light nonaqueous phase liquids (LNAPLs), although of the two, it is generally more difficult to remove or treat DNAPLs in the subsurface. (See *Ground-Water Rule of Thumb #10* for more complete discussion of DNAPLs.)
- 7) **Use of Institutional Controls:** Institutional controls (such as easements, well drilling prohibitions, building permit restrictions, land use zoning restrictions, or fishing bans) generally shall not substitute for more active measures (e.g., treatment and/or containment of source material) as the sole remedy unless active measures are not practicable, based on the balancing of trade-offs among alternatives that is conducted during the remedy selection process. Institutional controls typically will be used in conjunction with engineering controls when the remedy results in long-term waste management onsite. (40 CFR 300.430(a)(1)(iii)(D))



For Additional Information on Developing Remedial Alternatives:

- ☞ RI/FS Guidance: *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 540-G-89-004, October 1988).
- ☞ Principal Threats Guidance: *A Guide to Principal Threat and Low Level Threat Wastes* (OSWER Directive 9380.3-06FS, November 1991).
- ☞ Land Use Directive: *Land Use in the CERCLA Remedy Selection Process* (OSWER Directive 9355.7-04, May 25, 1995).
- ☞ Ground-Water Presumptive Strategy: *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites* (EPA 540-R-96-023, October 1996).

GROUND-WATER RESPONSE ACTIONS

Background

Contaminated ground water exists at over 85 percent of the sites on the National Priorities List (NPL). The goal of ground-water remediation at Superfund sites is to protect human health and the environment through a combination of short-term measures (e.g., provision of alternate water supplies) and long-term measures to restore ground-water quality appropriate for its beneficial uses. Remedial action for contaminated ground water generally is warranted when EPA determines, based on the results of the baseline risk assessment, that the contamination poses a current or potential threat to human health or the environment (CERCLA §104(a)(1)). Additionally, where the ground water is currently used (or is potentially usable) as a drinking water supply, exceedance of Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act also may be used as the basis for taking a remedial action. The goals of the long-term ground-water cleanup program are summarized in the NCP as follows:

"EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction" (40 CFR 300.430(a)(1)(iii)(F)).

Rules of Thumb for Ground-Water Response Actions

The rules of thumb for ground-water response actions are organized into four sequential steps. EPA recognizes that site investigation and analysis is a dynamic process that evolves as more information is gathered during the RI and a cleanup strategy is developed and refined in accordance with the best available site data. Hence, this framework is not strictly sequential, and should be tailored to address site-specific situations.



Key Ground-Water Response Questions

- What are the current and potential future beneficial uses of the contaminated ground water?
- What is the approximate timing of the future need for ground water?
- Is restoration of ground water to beneficial uses technically practicable within a reasonable timeframe?
- What is the range of remedial alternatives that restore ground water in different but "reasonable" time periods?
- If restoration is not technically practicable, what remedial activities are necessary to prevent exposure to contaminants and prevent further plume migration?

Step 1: Identifying Remedial Action Objectives and Preliminary Remediation Goals Based on Current and Potential Future Ground-Water Uses

Once it has been determined that there is a basis for taking a ground-water response action, the first step should be to identify RAOs and PRGs for the ground water. These RAOs and PRGs should reflect current and potential future uses of the ground water and exposure scenarios that are consistent with these uses. Several factors should be considered when identifying ground-water RAOs and PRGs:

- 1) **Current Ground-Water Uses:** RAOs and PRGs must reflect current human use (e.g., drinking water supply) as well as current environmental receptors (e.g., surface waters that are recharged by ground water and that are used by sensitive environmental receptors). (*Ground-Water Presumptive Strategy, page 15*)
- 2) **Potential Future Ground-Water Uses:** Where available, potential future ground-water uses should be determined from a Comprehensive State Ground-Water Protection Program (CSGWPP) that has been endorsed by EPA and has provisions for site-specific use determinations. In the absence of such a CSGWPP, determination of potential future uses should consider State ground water classifications or other designations and Federal ground-water guidelines (e.g., Class I, II, and III ground waters). The Federal classification system can be found in "*Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*," hereafter referred to as the Federal Guidelines. Where State and Federal classifications result in different ground-water use scenarios, the "use classification" leading to the more "stringent" RAOs should be used. Thus, ground waters at a given site are generally assumed to be a potential future source of drinking water if designated as such by the State or if considered to be a potential source of drinking water under the Federal Guidelines. (*CSGWPP Directive; Federal Guidelines; and 1990 NCP Preamble at 55 FR 8733*)
- 3) **PRGs for Drinkable Waters:** Generally, drinking water standards (Federal MCLs, non-zero MCLGs, or more stringent State drinking water standards) are relevant and appropriate as PRGs, and ultimately as final cleanup levels, for ground waters that are determined to be a current or potential future source of drinking water. (*40 CFR 300.430(e)(2)(i)(B and C); and Ground-Water Presumptive Strategy, page 15*)

- 4) **Limitation of Using Drinking Water Standards:** Generally, drinking water standards should not be chosen as PRGs for ground waters that are not current or potential future sources of drinking water (1990 NCP Preamble at 55 FR 8733). The Federal Guidelines define "non-potable," or Class III, ground-water aquifers as those that: contain more than 10,000 mg/liter total dissolved solids; yield less than 150 gallons per day; or are so contaminated by naturally occurring conditions (e.g., salinity) or broad-scale human activity not related to a specific contaminant source that cleanup is not practicable. State classification systems may also identify ground waters that are not considered to be a potential future source of drinking water (see Ground Water Rule of Thumb #2 above). Where non-potable ground water has been contaminated, non-restoration RAOs may be appropriate (e.g., source control, plume containment). Establishment of PRGs for non-potable ground-water should consider any surface or ground-water bodies to which such non-potable ground waters discharge, and any current or potential future uses of the non-potable ground water such as for livestock watering, agricultural irrigation, industrial uses, or other purpose that might result in human or environmental exposures. (*Ground-Water Presumptive Strategy, page 15*)
- 5) **Consideration of More Stringent Ground-Water Standards:** Many states have anti-degradation standards or other requirements that are more stringent than the Federal drinking water standards for a given constituent. Where such a state requirement is determined to be an ARAR, it should be used as the PRG. (*Ground-Water Presumptive Strategy, page 16*)
- 6) **Relationship between Ground-Water RAOs and Soil PRGs:** At many sites, soil PRGs are set at levels that are needed to achieve long-term RAOs for ground water. As a result, these soil PRGs may need to be more stringent than would otherwise be necessary given the reasonably anticipated future land use. However, stringent soil PRGs intended to protect ground water generally will be inappropriate for site areas where the primary source of ground-water contamination is located below the soil (e.g., DNAPLs below the water table) and restoration of ground water is determined to be technically impracticable (see *Ground-Water Rule of Thumb #9* below). Therefore, both reasonably anticipated future land uses and potential future ground-water uses must be considered when developing the overall site remediation strategy. (*Ground-Water Presumptive Strategy, page 12*)
- 7) **Relationship Between Ground Water and Other Water Resources:** Contaminated ground waters may discharge and pose a risk to environmental resources such as streams, lakes, wetlands, or other uncontaminated aquifers. Therefore, ground-water PRGs should be set at levels that are protective of these other resources as well. For example, cleanup of contaminated ground waters that discharge to surface water should consider whether water quality criteria established under the Clean Water Act, or more stringent state surface water requirements, are ARARs. (1990 NCP Preamble at 55 FR 8754)

Step 2: Establishing Remedial Action Objectives and Final Cleanup Levels Based on Site-Specific Conditions

Once ground-water RAOs have been identified (in accordance with current and potential future uses), PRGs associated with those objectives should be identified and factored into the remedy selection process. PRGs developed during the RI/FS, and in accordance with the principles presented in the previous section, are the starting point for determining final cleanup levels which are documented in the ROD. The following rules of thumb relate to flexibilities in existing EPA policy which allow for selection of achievable RAOs and their associated cleanup levels and points of compliance.

- 8) **Restoration Potential:** If ground-water restoration is determined to be the RAO, MCLs, non-zero MCLGs, or other risk-based cleanup levels will have to be achieved in order for the ground-water resource to be restored. Site-specific information should be analyzed to determine the likelihood that ground water can be restored to these levels using available technologies (i.e., to determine the aquifer's "restoration potential"). (*TI Guidance, page 13; and Ground-Water Presumptive Strategy, page 5*)
- 9) **Technical Impracticability:** An ARAR waiver should be invoked for those portions of the contaminated soil or ground water where it has been demonstrated that attainment of one or more ARARs are technically impracticable from an engineering perspective. The "TI" waiver must be justified by site-specific information developed for the Administrative Record in accordance with EPA guidance. In the event that a TI waiver is invoked, an "alternative remedial strategy" must be developed that will ensure protection of human health and the environment. This strategy should be incorporated into the decision document along with the waiver justification and should define achievable RAOs and final cleanup levels for the site. At a minimum, the alternative strategy should prevent human exposure to the contaminated ground water, prevent further contaminant migration, and define any other appropriate risk reduction measures. Note that the waiver should be invoked only for that portion of the contaminated ground water for which restoration to ARARs is technically impracticable. As a result, RAOs and final cleanup levels may be different for different portions of the contaminant plume. (*TI Guidance; and Ground-Water Presumptive Strategy, page 17*)
- 10) **DNAPL Sites:** The likelihood of the presence of dense nonaqueous phase liquids (DNAPLs) should be evaluated wherever DNAPL-type compounds (e.g., chlorinated solvents such as TCE) are found in significant concentrations in the ground water or are known to have been managed or disposed of at the site. The presence of DNAPLs can significantly impact the restoration potential of the site. Where DNAPLs (or other persistent contamination sources) are present in the subsurface and cannot practicably be removed, containment of such sources may be the most appropriate remediation goal. In such cases, a TI waiver should be invoked for the DNAPL zone. Where significant quantities of potentially mobile DNAPL are identified, extraction should be considered in conjunction with containment. Extraction of potentially mobile DNAPLs will increase the long-term reliability of the containment remedy as well as remove source material from the aquifer. Containment of the DNAPL zone will increase the

likelihood that the remaining portion of the aqueous phase plume can be restored to a beneficial use. (*Ground-Water Presumptive Strategy*, page 13; and *TI Guidance*, page 6)

- 11) **Point of Compliance:** Final cleanup levels for contaminated ground water generally should be attained throughout the entire contaminant plume, except when remedies involve areas where waste materials will be managed in place. In the latter case, cleanup levels should be achieved "at and beyond the edge of the waste management area when waste is left in place" (*1990 NCP Preamble at 55 FR 8713*). In some cases, such as where several distinct sources are in close geographic proximity, it may be appropriate to move the point of compliance to "encompass the sources of release." In such cases, the point of compliance may be defined to address the problem as a whole, rather than source by source. (*1990 NCP Preamble at 55 FR 8753*; and *Ground-Water Presumptive Strategy*, page 17)
- 12) **Alternate Concentration Limits (ACLs):** Under limited circumstances specified in CERCLA § 121(d)(2)(B)(ii), ACLs may be established in lieu of cleanup levels that would otherwise be ARARs (e.g., MCLs). The conditions under which ACLs may be considered are where: 1) contaminated ground water discharges to surface water; 2) such ground-water discharge does not lead to "statistically significant" increases of contaminants in the surface water; and 3) enforceable measures can be implemented to prevent human consumption of the contaminated ground water. In general, ACLs may be used where the preceding conditions are satisfied, and where restoration of the ground water is found to be impracticable, based on a balancing of the remedy selection criteria. (*1990 NCP Preamble at 55 FR 8732 and 8754*; and *Ground-Water Presumptive Strategy*, page 18)

Step 3: Evaluating Remedial Technologies and Cleanup Time Frames

Following the establishment of achievable remedial action objectives, cleanup levels, and areas of compliance, a remediation technology (or combination of technologies) should be selected from those identified in the Feasibility Study. The principal factors to consider at this stage are how quickly the remedial action objectives need to be achieved, and what remediation strategies and technologies should be used to achieve them. These factors will have a significant impact on the type of remedy chosen for the site, as well as the cost of that remedy.

- 13) **Using Early Actions:** Early actions, such as a removal or interim remedial action taken before the final remedy is selected, should be used where appropriate to reduce site risks early in the site remediation process. In addition to reducing site risks and controlling further contaminant migration, these activities will also provide additional site characterization information that greatly improves the ability to make sound long-term remedy decisions. (*Ground-Water Presumptive Strategy*, page 16; and *SACM Guidance*)
- 14) **Restoration Time Frames:** Where the contaminated ground water is not currently used or an alternate water source is readily available, and there is no near-term future need for the

resource, it will likely be appropriate to consider a longer time frame for achieving restoration cleanup levels. Where longer remediation time frames are appropriate, less aggressive remediation methods and/or more passive remediation approaches (such as source control combined with monitored natural attenuation) should be considered. Restoration time frames should be estimated for all viable remedial alternatives being considered for the site (40 CFR 300.430(e)(4)). Comparison of aggressive and passive remedial alternatives can provide a helpful basis for identifying the range of time periods that will be needed to attain remediation objectives, and will provide the basis for determining the remediation timeframe and technologies appropriate for the site. (1990 NCP Preamble at 55 FR 8732; and *Ground-Water Presumptive Strategy*, page 16)

- 15) **Innovative Technologies:** New and emerging technologies should be evaluated in the FS if such technologies offer "the potential for comparable or superior performance or implementability; fewer or lesser adverse impacts than other available approaches; or lower costs for similar levels of performance than demonstrated treatment technologies" (40 CFR 300.430(e)(5)).
- 16) **Monitored Natural Attenuation:** At some sites, data gathered during the RI/FS may indicate that physical or biological processes (unassisted by human intervention) may effectively reduce contaminant concentrations such that remedial objectives in the contaminant plume (or certain portions of the plume) may be achieved in a reasonable time frame without active remediation. This approach is most likely to be appropriate in low concentration portions of the plume, where source control actions have removed the bulk of the contaminant mass, or where biodegradation will efficiently destroy the contaminants in situ. In some cases, remediation alternatives that combine active remediation (in source areas or areas of high concentration) with monitored natural attenuation (in lower concentration portions of the plume) may be most appropriate. Sufficient information is necessary to demonstrate that natural processes are capable of achieving remedial objectives for the site. Performance monitoring is a critical component of this remediation approach because monitoring is needed to ensure that the remedy is protective and that natural processes are reducing contamination levels as expected. Sites with contaminants that do not readily attenuate, or sites that require relatively rapid cleanup due to the demand for the ground-water resource, generally will not be appropriate candidates for natural attenuation. (1990 NCP Preamble at 55 FR 8734; *Ground-Water Presumptive Strategy*, page 18; and *Natural Attenuation Guidance*)

- 17) **Presumptive Treatment Technologies:** Generally, selection of technologies for ex-situ (above ground) treatment of extracted ground water should employ one or more of the presumptive technologies identified in the *Ground-Water Presumptive Strategy*. The engineering capabilities of these presumptive treatment technologies are well understood, enabling the selection process to be streamlined for the ex-situ treatment component of a ground-water remedy.

Step 4: Monitoring and Evaluating Remedy Performance

Selection of the site remedy marks the end of a data gathering, study, and decision-making process and marks the beginning of the cleanup phase, which includes designing, constructing, operating and maintaining the remedy. Since most ground-water remedies are expected to be operated, maintained, and/or monitored for long periods of time, further opportunities for improving the performance and cost-effectiveness of the cleanup should be explored and utilized if appropriate. An ongoing Administrative reform initiative highlights EPA's recent efforts to encourage appropriate changes to existing remedy decisions to enhance overall remedy effectiveness and cost-effectiveness, without compromising protectiveness or other objectives of the Superfund program. (See *Remedy Updates Guidance* for more information.) The following principles describe how periodic evaluation of a remedy can lead to improvements in performance and shortened cleanup time frames.

- 18) **Implementing Remedies in Multiple Phases:** Implementation of ground-water remedies in more than one phase may increase the performance and cost-effectiveness of the long-term remedy. Performance data from an early phase can be used to refine the design of later phases so that the ultimate remedy is optimized for actual site conditions (e.g., optimized number, location, and pumping rate of extraction wells). (*Ground-Water Presumptive Strategy*, page 5 and page 12)
- 19) **Periodic Review:** Performance of the ongoing remedy should be evaluated on a regular basis (e.g., every 1 to 5 years) to compare anticipated with actual results, to identify any potential deficiencies in the remedy's protectiveness, and to seek opportunities to improve its performance over the long term. This is especially important when the selected remedy relies on monitored natural attenuation. (*Ground-Water Presumptive Strategy*, page 8; and *Natural Attenuation Guidance*)
- 20) **Improving Remedy Performance:** Ground-water remedies often involve multiple extraction and/or injection points, subsurface structures or containment barriers, and other features whose actual performance in the field may vary from that assumed during design, given uncertainties about subsurface geology prior to construction. Careful assessment of performance monitoring data may be used to refine the remedy, such as modifying extraction rates or changing the pattern of extraction wells. Such improvements are capable of shortening cleanup time frames, and thus reducing costs. (*Ground-Water Presumptive Strategy*, page 11)
- 21) **Revisiting and Modifying Cleanup Goals:** At some sites it may be necessary to revisit the

ROD's remedial action objectives or final cleanup levels, if performance data indicate that attainment of these objectives or levels is not technically practicable. If it is determined that a TI waiver is appropriate, the waiver generally should be invoked in a ROD amendment, although in some cases an Explanation of Significant Differences (ESD) may be sufficient. An ESD may be used where the revised remedy is generally consistent with the "alternative remedial strategy" discussed in the original ROD and the original ROD: 1) contained detailed discussions of the potential need for a future TI waiver, and 2) identified an alternative remedial strategy to be used in the event a TI waiver was determined to be appropriate for the site. If an ESD is determined to be sufficient, public notice and opportunity for comment should also be provided. (*Ground-Water Presumptive Strategy*, page 11; *TI Guidance*, page 19 and 24; and *Remedy Updates Guidance*)



For Additional Information on Ground Water Response Actions:












-  **Federal Guidelines:** *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy, Final Draft* (EPA Office of Water, November 1986).
-  **Ground-Water Guidance:** *Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites* (EPA 540-G-88-003, December 1988).
-  **Role of Baseline Risk Assessment Directive:** *Role of the Baseline Risk Assessment in Superfund Remedy Selection* (OSWER Directive 9355.0-30, April 22, 1991).
-  **DNAPL I:** *Estimating Potential for Occurrence of DNAPL at Superfund Sites* (OSWER Publication 9355.4-07FS, January 1992).
-  **SACM Guidance:** *Guidance on Implementation of the Superfund Accelerated Cleanup Model (SACM) under CERCLA and the NCP* (OSWER Directive 9203.1-03, July 7, 1992). Five additional fact sheets also describe SACM and are available by citing the following reference: OSWER Directive 9203.1-05I (Volume 1, Numbers 1-5), December 1992.
-  **TI Guidance:** *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA 540-R-93-080, September 1993).
-  **DNAPL II:** *DNAPL Site Characterization* (OSWER Publication 9355.4-16FS, September 1994).
-  **Remedy Updates Guidance:** *Superfund Reforms: Updating Remedy Decisions* (OSWER Directive 9200.0-22, September 27, 1996).
-  **Ground Water Presumptive Strategy:** *Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites* (EPA 540-R-96-023, October 1996).
-  **CSGWPP Directive:** *The Role of CSGWPPs in EPA Remediation Programs* (OSWER Directive 9283.1-09, April 4, 1997).
-  **Natural Attenuation Guidance:** *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (OSWER Directive 9200.4-17, DRAFT).

Exhibit P

United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington, DC 20460

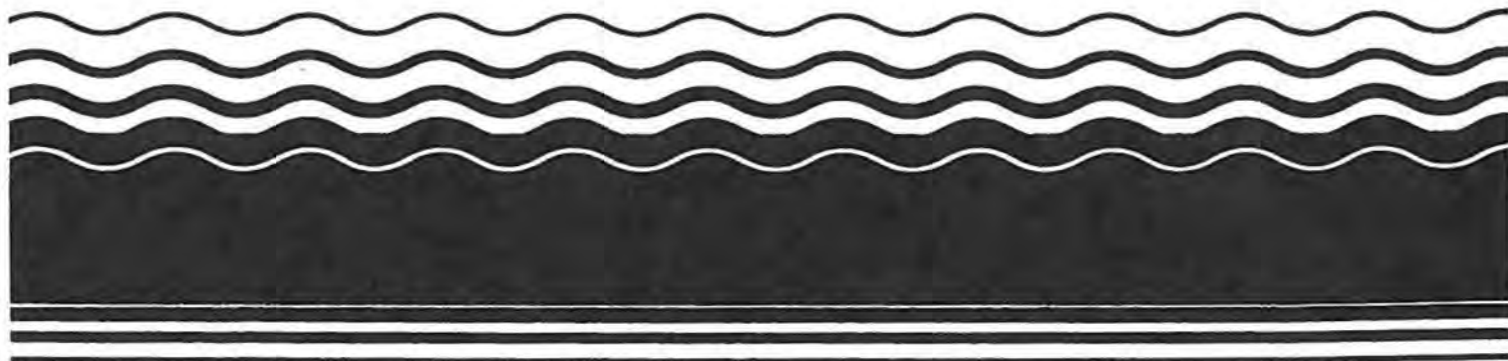
PE89-184626
EPA/540/G-89/004
OSWER Directive 9355.3-01
October 1988

Superfund



Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA

Interim Final



EPA/540/G-89/004
OSWER Directive 9355.3-01
October 1988

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Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, D.C. 20460

NL-RBS 000552

Notice

Development of this document was funded, wholly or in part, by the United States Environmental Protection Agency under Contract No. 68-W8-0098. It has been subjected to the Agency's review process and approved for publication as an EPA document.

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Glossary

ARAR	Applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry: A branch of the Centers for Disease Control that is responsible for preparing health assessments at sites.
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund: Amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA).
CLP	Contract Laboratory Program
CRL	Central regional laboratory
CRP	Community relations plan
CWA	Clean Water Act
DQO	Data quality objectives: Statements that specify the data needed to support decisions regarding remedial response activities.
EMSL-LV	Environmental Monitoring Systems Laboratory, Las Vegas
EPIC	Environmental Photographic Interpretation Center
ERA	Expedited response action
ESI	Expanded site investigation
FIT	Field investigation team
FS	Feasibility study
FSP	Field sampling plan: Defines in detail the sampling and data gathering activities to be used at a site. (See SAP.)
HSP	Health and safety plan
IRIS	Integrated Risk Information System
Lead agency	The agency, either the EPA, Federal agency, or appropriate State agency having primary responsibility and authority for planning and executing the remediation at a site.
MCL	Maximum contaminant level: Established under the Safe Drinking Water Act.
MCLG	Maximum contaminant level goal: Established under the Safe Drinking Water Act.
MPRSA	Marine Protection Research and Sanctuaries Act
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	National Environmental Policy Act

NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List: A list of sites identified for remediation under CERCLA.
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
q*	Cancer potency factor: The lifetime cancer risk for each additional mg/kg body weight per day of exposure.
PRP	Potentially responsible party
QA	Quality assurance
QAPP	Quality assurance project plan: A plan that describes protocols necessary to achieve the data quality objectives defined for an RI. (See SAP.)
QC	Quality control
RAS	Routine analytical services
RCRA	Resource Conservation and Recovery Act
RD	Remedial design
RfD	The reference dose (RfD) is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime.
RI/FS	Remedial investigation/ feasibility study
ROD	Record of Decision: Documents selection of cost-effective Superfund-financed remedy.
RPM	Remedial Project Manager: The project manager for the lead Federal agency.
SAP	Sampling and analysis plan, consisting of a quality assurance project plan (QAPP) and a field sampling plan (FSP).
SARA	Superfund Amendments and Reauthorization Act of 1986. (See CERCLA.)
SAS	Special analytical services
SDWA	Safe Drinking Water Act
SI	Site investigation
SITE	Superfund innovative technology evaluation
SOP	Standard operating procedures
s o w	Statement of Work
SPHEM	Superfund public health evaluation manual
SWDA	Solid Waste Disposal Act
TAT	Technical assistance team
TBC	To be considered
TCL	Target compound list
TOM	Technical directive memorandum
TSCA	Toxic Substances Control Act
WPRR	Work plan revision request

Acknowledgments

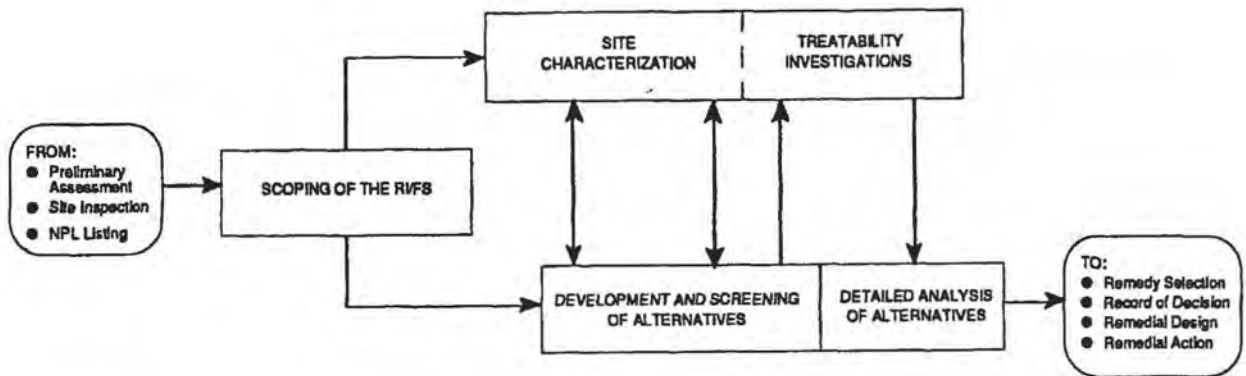
This document was developed by EPA's Office of Emergency and Remedial Response (OERR) with assistance provided by CH2M HILL in partial fulfillment of Contracts No. 68-01-7090 and 68-W8-0098. Steven C. Golian served as EPA project manager, with assistance from Elizabeth A. Shaw. The CH2M HILL project team included Elizabeth Dodge, Brint Bixler, Phil Smith, Julie Pfeffer, Brian Marshall, Bill Gould, and Jeannie Massie.

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CHAPTER 1

INTRODUCTION



Chapter 1

Introduction

1.1 Purpose of the RI/FS

The remedial investigation and feasibility study (RI/FS) process as outlined in this guidance represents the methodology that the Superfund program has established for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. This approach should be viewed as a dynamic, flexible process that can and should be tailored to specific circumstances of individual sites; it is not a rigid step-by-step approach that must be conducted identically at every site. The project manager's central responsibility is to determine how best to use the flexibility built into the process to conduct an efficient and effective RI/FS that achieves high quality results in a timely and cost-effective manner. A significant challenge project managers face in effectively managing an RI/FS is the inherent uncertainties associated with the remediation of uncontrolled hazardous waste sites. These uncertainties can be numerous, ranging from potential unknowns regarding site hydrogeology and the actual extent of contamination, to the performance of treatment and engineering controls being considered as part of the remedial strategy. While these uncertainties foster a natural desire to want to know more, this desire competes with the Superfund program's mandate to perform cleanups within designated schedules.

The objective of the RI/FS process is not the unobtainable goal of removing *all* uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site. The appropriate level of analysis to meet this objective can only be reached through constant strategic thinking and careful planning concerning the essential data needed to reach a remedy selection decision. As hypotheses are tested and either rejected or confirmed, adjustments or choices as to the appropriate course for further investigations and analyses are required. These choices, like the remedy selection itself, involve the balancing of a wide variety of factors and the exercise of best professional judgment.

1.2 Purpose of the Guidance

This guidance document is a revision of the U.S. Environmental Protection Agency's (EPA) *Guidance on Remedial Investigations Under CERCLA* (May 1985) and *Guidance on Feasibility Studies Under CERCLA* (June 1985). These guidances have been consolidated into a single document and revised to (1) reflect new emphasis and provisions of the Superfund Amendments and Reauthorization Act (SARA), (2) incorporate aspects of new or revised guidance related to aspects of remedial investigations and feasibility studies (RI/FSs), (3) incorporate management initiatives designed to streamline the RI/FS process, and (4) reflect experience gained from previous RI/FS projects.

The purpose of this guidance is to provide the user with an overall understanding of the RI/FS process. Expected users include EPA personnel, State agencies responsible for coordinating or directing activities at National Priorities List (NPL) sites, potentially responsible parties (PRPs), Federal facility coordinators, and consultants or companies contracted to assist in RI/FS-related activities at NPL sites. This guidance describes the general procedures for conducting an RI/FS.¹ Where specific guidance is currently available elsewhere, the RI/FS guidance will simply highlight the key points or concepts as they relate to the RI/FS process and refer the user to the other sources for additional details.

1.3 Overview of CERCLA Reauthorization

SARA was signed by the President on October 17, 1986, to amend the Comprehensive Environmental Response, Compensation, and Liability Act of 1980

¹This guidance document does not typically address differences in the general procedures (e.g., work plan preparation, reporting requirements) between a Fund-financed and PRP-conducted RI/FS, and the flexibility discussed for certain activities may not pertain to a PRP-conducted RI/FS. Therefore, when PRPs are conducting an RI/FS, this guidance document must be used in conjunction with the "Interim Guidance on PRP Participation in the RI/FS Process" (see Appendix A).

(CERCLA). While SARA did not change the basic structure of CERCLA, it did modify many of the existing requirements and added new ones. References made to CERCLA throughout this document should be interpreted as meaning "CERCLA as amended by SARA."

Many of the new provisions under CERCLA having the greatest impact on the RI/FS process are contained in §121 (Cleanup Standards). Other notable changes that also affect the RI/FS process are contained in §104 (Response Authorities, in particular Health-Related Authorities), portions of §104 and §121 regarding State involvement, §117 (Public Participation), §110 (Worker Protection Standards), and §113 (Civil Proceedings). Highlights of these sections are summarized below.

1.3.1 Cleanup Standards

Section 121 (Cleanup Standards) states a strong statutory preference for remedies that are highly reliable and provide long-term protection. In addition to the requirement for remedies to be both protective of human health and the environment and cost-effective, additional remedy selection considerations in 5121(b) include:

- A preference for remedial actions that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants as a principal element
- Offsite transport and disposal without treatment is the least favored alternative where practicable treatment technologies are available
- The need to assess the use of permanent solutions and alternative treatment technologies or resource recovery technologies and use them to the maximum extent practicable

Section 121 (c) also requires a periodic review of remedial actions, at least every 5 years after initiation of such action, for as long as hazardous substances, pollutants, or contaminants that may pose a threat to human health or the environment remain at the site. If it is determined during a 5-year review that the action no longer protects human health and the environment, further remedial actions will need to be considered.

1.3.1.1 Applicable or Relevant and Appropriate Requirements

Section 121(d)(2)(A) of CERCLA incorporates into law the CERCLA Compliance Policy, which specifies that Superfund remedial actions meet any Federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant

and appropriate requirements (ARARs). Also included is the new provision that State ARARs must be met if they are more stringent than Federal requirements. Federal statutes that are specifically cited in CERCLA include the Solid Waste Disposal Act (SWDA), the Toxic Substances Control Act (TSCA), the Safe Drinking Water Act (SDWA), the Clean Air Act (CAA), the Clean Water Act (CWA), and the Marine Protection Research and Sanctuaries Act (MPRSA). Additional guidance on ARARs is provided in the "CERCLA Compliance with Other Statutes" manual (U.S. EPA, Draft, August 1988).

Section 121(d)(4) of CERCLA identifies six circumstances under which ARARs may be waived:

- The remedial action selected is only a part of a total remedial action (interim remedy) and the final remedy will attain the ARAR upon its completion.
- Compliance with the ARAR will result in a greater risk to human health and the environment than alternative options.
- Compliance with the ARAR is technically impracticable from an engineering perspective.
- An alternative remedial action will attain an equivalent standard of performance through the use of another method or approach.
- The ARAR is a State requirement that the state has not consistently applied (or demonstrated the intent to apply consistently) in similar circumstances.
- For §104 Superfund-financed remedial actions, compliance with the ARAR will not provide a balance between protecting human health and the environment and the availability of Superfund money for response at other facilities.

1.3.1.2 Offsite Facilities

The new statutory requirements contained in §121 (d)(3) for acceptable offsite disposal facilities, in most respects, incorporate previous Agency policy. Offsite disposal facilities receiving contaminants must be in compliance with Resource Conservation and Recovery Act (RCRA) and other Federal and State laws. In addition, the unit receiving the waste must have no releases to ground water, surface water, or soil; other units that have had releases at the facility must be under an approved corrective action program.

1.3.2 Health Assessments

Under CERCLA §104(i) (Health-Related Authorities), the Agency for Toxic Substances and Disease

Registry (ATSDR) must conduct a health assessment for every site proposed for inclusion on the NPL. The purpose of these health assessments is to assist in determining whether current or potential risk to human health exists at a site and whether additional information on human exposure and associated health risks is needed. The health assessment is required to be completed "to the maximum extent practicable" before completion of the RI/FS.

1.3.3 State Involvement

Section 104(c)(3)(C) of CERCLA remains in effect requiring a 10-percent State cost share for remedial actions at privately operated sites and 50 percent at publicly operated sites.² Section 104(c)(3)(A) and 104(c)(6) of CERCLA provide that the operation and maintenance of ground- and surface-water restoration measures be considered part of remedial action for up to 10 years after commencement of operations or until remedial action is complete, whichever is earlier. Therefore, such activities during the 10-year period would be eligible for either 50 or 90 percent Federal funding depending on whether the site was publicly or privately operated.

Section 121(d)(2)(A) of CERCLA specifies that more stringent State ARARs apply if they are identified in a timely manner by the state. Section 121 (f) requires EPA to develop regulations for substantial and meaningful State involvement in the remedial response process and specifies certain minimum requirements.

1.3.4 Community Involvement

Section 117 of CERCLA (Public Participation) emphasizes the importance of early, constant, and responsive relations with communities affected by Superfund sites and codifies, with some modifications, current community relations activities applied at NPL sites. Specifically, the law requires publication of a notice of any proposed remedial action (proposed plan) in a local newspaper of general circulation and a "reasonable opportunity" for the public to comment on the proposed plan and other contents of the administrative record, particularly the RI and the FS. In addition, the public is to be afforded an opportunity for a public meeting. The proposed plan should include a brief explanation of the alternatives considered, which will usually be in the form of a summary of the FS. Unlike the FS, however, the proposed plan will also provide an explanation of the preliminary preference for one of the options. Notice of the final plan adopted and an explanation of any significant changes from the proposed plan are also required. CERCLA also

authorizes technical assistance grants for local citizens' groups potentially affected by an NPL site. The grants are to be used in obtaining assistance in interpreting information on the nature of hazards posed by the site, the results of the RI/FS, any removal actions, the Record of Decision (ROD), and the remedial design and remedial action.

1.3.5 Administrative Record

Section 113 of CERCLA requires that an administrative record be established "at or near the facility at issue." The record is to be compiled contemporaneously and must be available to the public and include all information considered or relied on in selecting the remedy, including public comments on the proposed plan.

1.3.6 Worker Safety

Section 126(c) of CERCLA directed the Occupational Safety and Health Administration (OSHA) to issue, within 60 days of the date of enactment of SARA, an interim final rule that contains employee protection requirements for workers engaged in hazardous waste operations. OSHA's interim final rule (29 CFR 1910.120) was published in the *Federal Register* on December 19, 1986, with full implementation of this rule required by March 16, 1987. The worker safety rule will remain in effect until the final standard is issued by OSHA and becomes effective.

1.3.7 Enforcement Authorities

Section 122(e) authorizes EPA to use "special notice" procedures, which for an RI/FS, establishes a 60-day moratorium period to provide time for formal negotiation between EPA and the PRPs for conduct of the RI/FS activities. This 60-day period may be extended to 90 days if within the 60-day time period, the potentially responsible parties (PRPs) provide EPA with a good faith offer to conduct or finance the RI/FS.

SARA allows for administrative consent orders to be signed using the authorities of Section 122(d)(3) as pertaining to Section 104(b) without having to make a finding of imminent and substantial endangerment. Section 104(a)(1) outlines special requirements for a PRP-lead RI/FS. These requirements include: making the determination that a PRP is qualified to perform the RI/FS; arranging for a third party to assist in oversight of the RI/FS; and requiring that PRPs pay for third party oversight.³

²Remedial planning activities for the RI/FS and remedial design continue to be 100 percent federally funded.

³Specific guidance on PRP participation in the RI/FS process is found in Appendix A. Detailed guidance on PRP oversight is currently under preparation in the Office of Solid Waste and Emergency Response (OSWER).

1.4 The RI/FS Process Under CERCLA

Although the new provisions of CERCLA have resulted in some modifications to the RI/FS process, the basic components of the process remain intact. The RI continues to serve as the mechanism for collecting data to characterize site conditions; determine the nature of the waste; assess risk to human health and the environment; and conduct treatability testing as necessary to evaluate the potential performance and cost of the treatment technologies that are being considered. The latter also supports the design of selected remedies. The FS continues to serve as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

The various steps, or phases, of the RI/FS process and how they have been modified to comply with the new provisions in CERCLA are summarized below. It is important to note that the RI and FS are to be conducted concurrently and that data collected in the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and scope of treatability studies and additional field investigations. Two concepts are essential to the phased RI/FS approach. First, data should generally be collected in several stages, with initial data collection efforts usually limited to developing a general understanding of the site. As a basic understanding of site characteristics is achieved, subsequent data collection efforts focus on filling identified gaps in the understanding of site characteristics and gathering information necessary to evaluate remedial alternatives. Second, this phased sampling approach encourages identification of key data needs as early in the process as possible to ensure that data collection is always directed toward providing information relevant to selection of a remedial action. In this way the overall site characterization effort can be continually scoped to minimize the collection of unnecessary data and maximize data quality.

Because of the interactive and iterative nature of this phase of the RI and FS process, the sequence of the various phases and associated activities, as described below and presented in Figure 1-1, will frequently be less distinct in practice. A generic timeline intended to illustrate the phasing of RI/FS activities is presented in Figure 1-2. The actual timing of individual activities will depend on specific site situations.

1.4.1 Scoping

Scoping is the initial planning phase of the RI/FS process, and many of the planning steps begun here are continued and refined in later phases of the RI/FS. Scoping activities typically begin with the collection of existing site data, including data from

previous investigations such as the preliminary assessment and site investigation. On the basis of this information, site management planning is undertaken to preliminarily identify boundaries of the study area, identify likely remedial action objectives and whether interim actions may be necessary or appropriate, and to establish whether the site may best be remedied as one or several separate operable units. Once an overall management strategy is agreed upon, the RI/FS for a specific project or the site as a whole is planned. Typical scoping activities include:

- Initiating the identification and discussion of potential ARARs with the support agency
- Determining the types of decisions to be made and identifying the data and other information needed to support those decisions
- Assembling a "technical advisory committee" to assist in these activities, to serve as a review board for important deliverables, and to monitor progress, as appropriate, during the study
- Preparing the work plan, the sampling and analysis plan (SAP) (which consists of the quality assurance project plan (QAPP) and the field sampling plan (FSP)), the health and safety plan, and the community relations plan

Chapter 2 describes the various steps in the scoping process and gives general information on work-planning methods that have been effective in planning and executing past RI/FSs.

1.4.2 Site Characterization

During site characterization, field sampling and laboratory analyses are initiated. Field sampling should be phased⁴ so that the results of the initial sampling efforts can be used to refine plans developed during scoping to better focus subsequent sampling efforts. Data quality objectives are revised as appropriate based on an improved understanding of the site to facilitate a more efficient and accurate characterization of the site and, therefore, achieve reductions in time and cost.

A preliminary site characterization summary is prepared to provide the lead agency with information on the site early in the process before preparation of the full RI report. This summary will be useful in determining the feasibility of potential technologies and in assisting both the lead and support agencies with the initial identification of ARARs. It can also be

⁴Emphasis is placed on rapid turnaround of sampling results to avoid the need to remobilize and reprocur contractors.

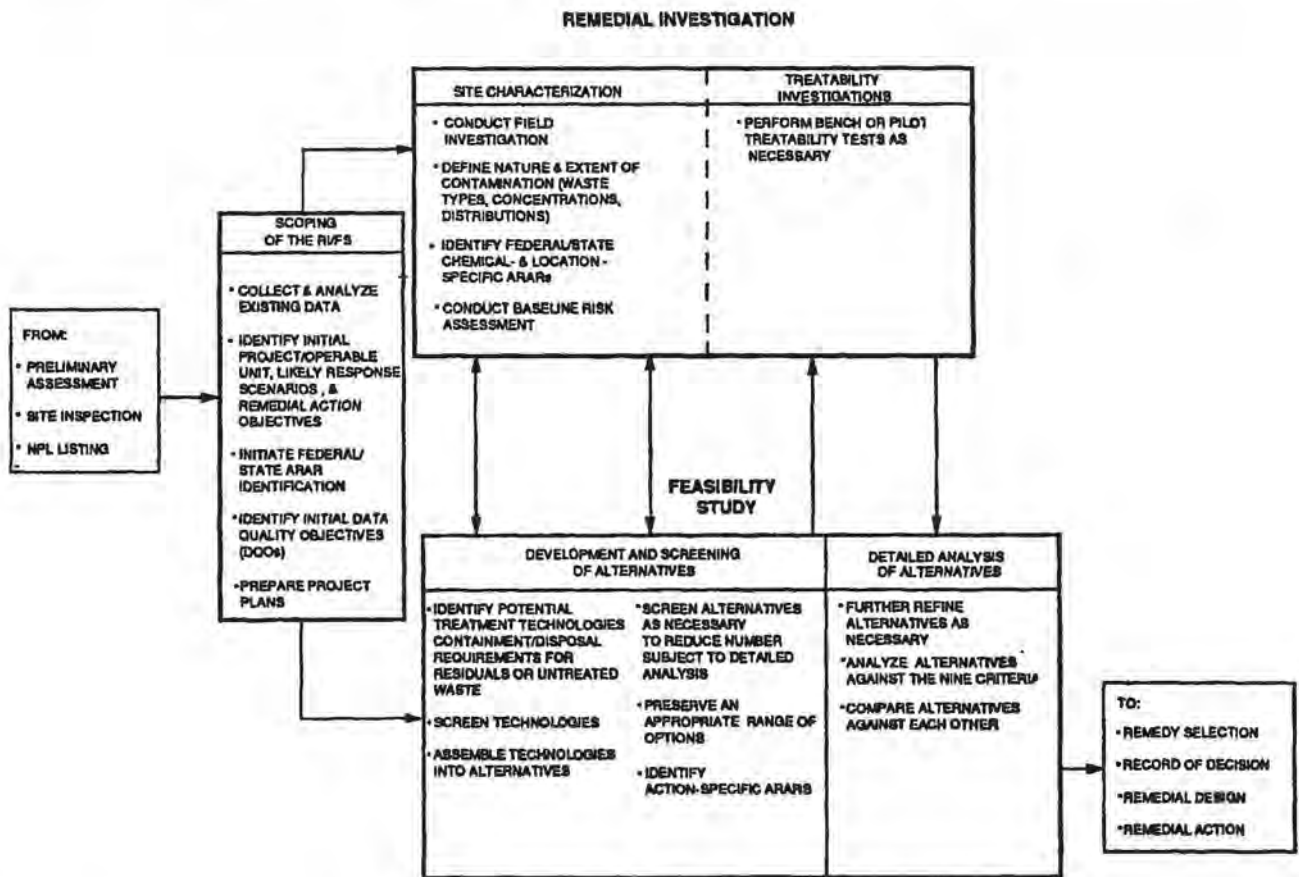


Figure 1-1. Phased RI/FS Process.

sent to ATSDR to assist them in performing their health assessment of the site.

A baseline risk assessment is developed to identify the existing or potential risks that may be posed to human health and the environment by the site. This assessment also serves to support the evaluation of the no-action alternative by documenting the threats posed by the site based on expected exposure scenarios. Because this assessment identifies the primary health and environmental threats at the site, it also provides valuable input to the development and evaluation of alternatives during the FS. Site characterization activities are described in Chapter 3.

1.4.3 Development and Screening of Alternatives

The development of alternatives usually begins during or soon after scoping, when likely response scenarios may first be identified. The development of alternatives requires (1) identifying remedial action objectives; (2) identifying potential treatment, resource recovery, and containment technologies that will satisfy these objectives; (3) screening the

technologies based on their effectiveness, implementability, and cost; and (4) assembling technologies and their associated containment or disposal requirements into alternatives for the contaminated media at the site or for the operable unit. Alternatives can be developed to address contaminated medium (e.g., ground water), a specific area of the site (e.g., a waste lagoon or contaminated hot spots), or the entire site. Alternatives for specific media and site areas either can be carried through the FS process separately or combined into comprehensive alternatives for the entire site. The approach is flexible to allow alternatives to be combined at various points in the process.

As practicable, a range of treatment alternatives, should be developed, varying primarily in the extent to which they rely on long-term management of residuals and untreated wastes. The upper bound of the range would be an alternative that would eliminate, to the extent feasible, the need for any long-term management (including monitoring) at the site. The lower bound would consist of an alternative that involves treatment as a principal element (i.e., treatment is used to address the principal threats at

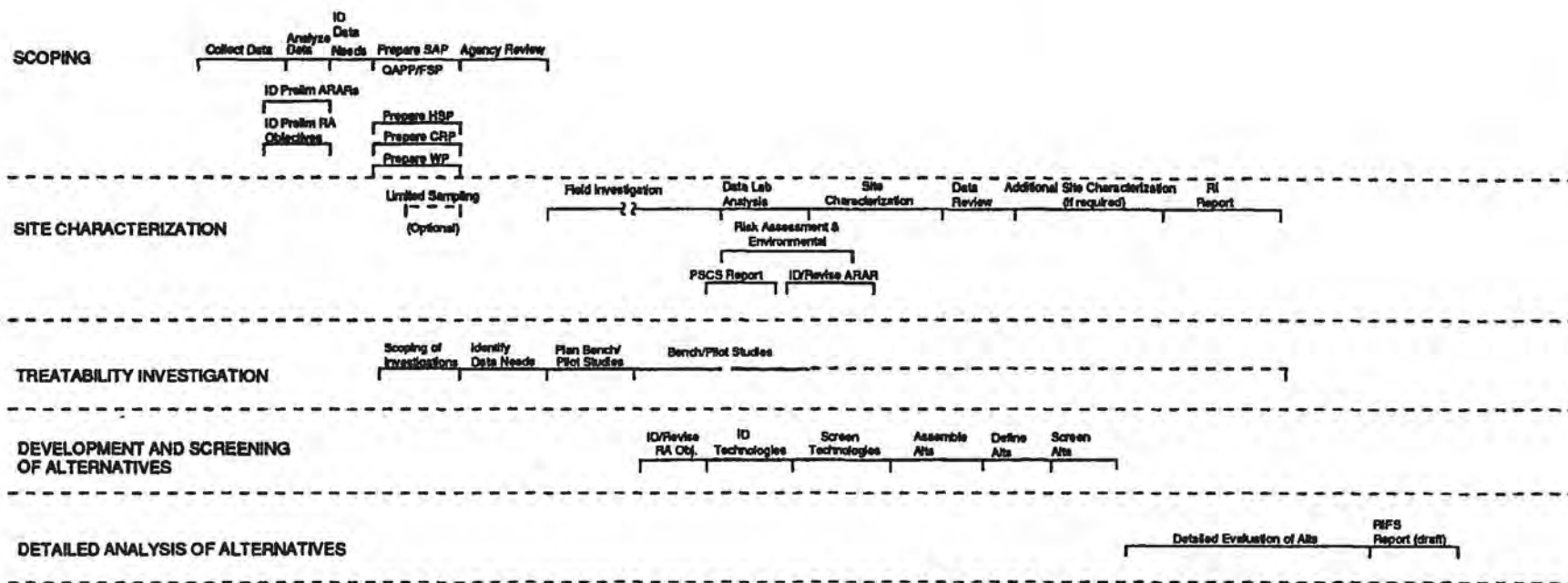


Figure 1-2. Generic Phased RI/FS Timeline.

the site), but some long-term management of portions of the site that did not constitute "principal threats" would be required. Between the upper and lower bounds of the treatment range, alternatives varying in the type and degrees of treatment and associated containment/ disposal requirements should be included as appropriate. In addition, one or more containment option(s) involving little or no treatment should be developed as appropriate, and a no-action alternative should always be developed.

Once potential alternatives have been developed, it may be necessary to screen out certain options to reduce the number of alternatives that will be analyzed in detail in order to minimize the resources dedicated to evaluating options that are less promising. The necessity of this screening effort will depend on the number of alternatives initially developed, which will depend partially on the complexity of the site and/ or the number of available, suitable technologies. For situations in which it is necessary to reduce the initial number of alternatives before beginning the detailed analysis, a range of alternatives should be preserved, as practicable, so that the decisionmaker can be presented with a variety of distinct, viable options from which to choose. The screening process involves evaluating alternatives with respect to their effectiveness, implementability, and cost. It is usually done on a general basis and with limited effort (relative to the detailed analysis) because the information necessary to fully evaluate the alternatives may not be complete at this point in the process. The development and screening of alternatives is discussed in Chapter 4.

1.4.4 Treatability Investigations

Should existing site and/or treatment data be insufficient to adequately evaluate alternatives, treatability tests may be necessary to evaluate a particular technology on specific site wastes. Generally, treatability tests involve bench-scale testing to gather information to assess the feasibility of a technology. In a few situations, a pilot-scale study may be necessary to furnish performance data and develop better cost estimates so that a detailed analysis can be performed and a remedial action can be selected. To conduct a pilot-scale test and keep the RI/FS on schedule, it will usually be necessary to identify and initiate the test at an early point in the process. Treatability investigations are described in Chapter 5.

1.4.5 Detailed Analysis

Once sufficient data are available, alternatives are evaluated in detail with respect to nine evaluation criteria that the Agency has developed to address the statutory requirements and preferences of CERCLA. The alternatives are analyzed individually against each criterion and then compared against one

another to determine their respective strengths and weaknesses and to identify the key tradeoffs that must be balanced for that site. The results of the detailed analysis are summarized and presented to the decisionmaker so that an appropriate remedy consistent with CERCLA can be selected. The detailed analysis of alternatives is described in Chapter 6.

1.5 Special Sites

The use of treatment technologies and, therefore, the development of a complete range of options, may not be practicable at some sites with large volumes of low concentration wastes (e.g., large municipal landfills or mining sites). Remedies involving treatment at such sites may be prohibitively expensive or difficult to implement. Therefore, the range of alternatives initially developed may be focused primarily on various containment options. Although this guidance does not specifically state how all such sites should be addressed, factors are discussed that can be used, as appropriate, to help guide the development and evaluation of alternatives on a case-by-case basis.

1.6 Community Relations

Community relations is a useful and important aspect of the RI/FS process. Community relations activities serve to keep communities informed of the activities at the site and help the Agency anticipate and respond to community concerns. A community relations plan is developed for a site as the work plan for the RI/FS is prepared. The community relations plan is based on interviews with interested people in the community and will provide the guidelines for future community relations activities at the site. At a minimum, the plan must provide for a site mailing list, a conveniently located place for access to all public information about the site, an opportunity for a public meeting when the RI/FS report and proposed plan are issued, and a summary of public comments on the RI/FS report and proposed plan and the Agency's response to those comments.

The specific community relations requirements for each phase of the RI/FS are integrated throughout this guidance document since they are parallel to and support the technical activities. Each chapter of this guidance has a section discussing community relations requirements appropriate to that specific phase of the RI/FS. Additional program requirements are described in the draft of *Community Relations in Superfund: A Handbook* (U.S. EPA, Interim, June 1988).

1.7 Lead and Support Agency

Throughout this guidance the terms "lead agency" and "support agency" are used to reflect the fact that

either EPA or a State or Federal facility can have the lead responsibility for conducting an RI/FS. The support agency plays a review and concurrence role and provides specific information as necessary to the lead agency (e.g., ARAR identification). The roles of the lead and support agencies in each phase of the RI/FS process are described at the end of each chapter.

1.8 Remedial Project Manager Role and Responsibilities

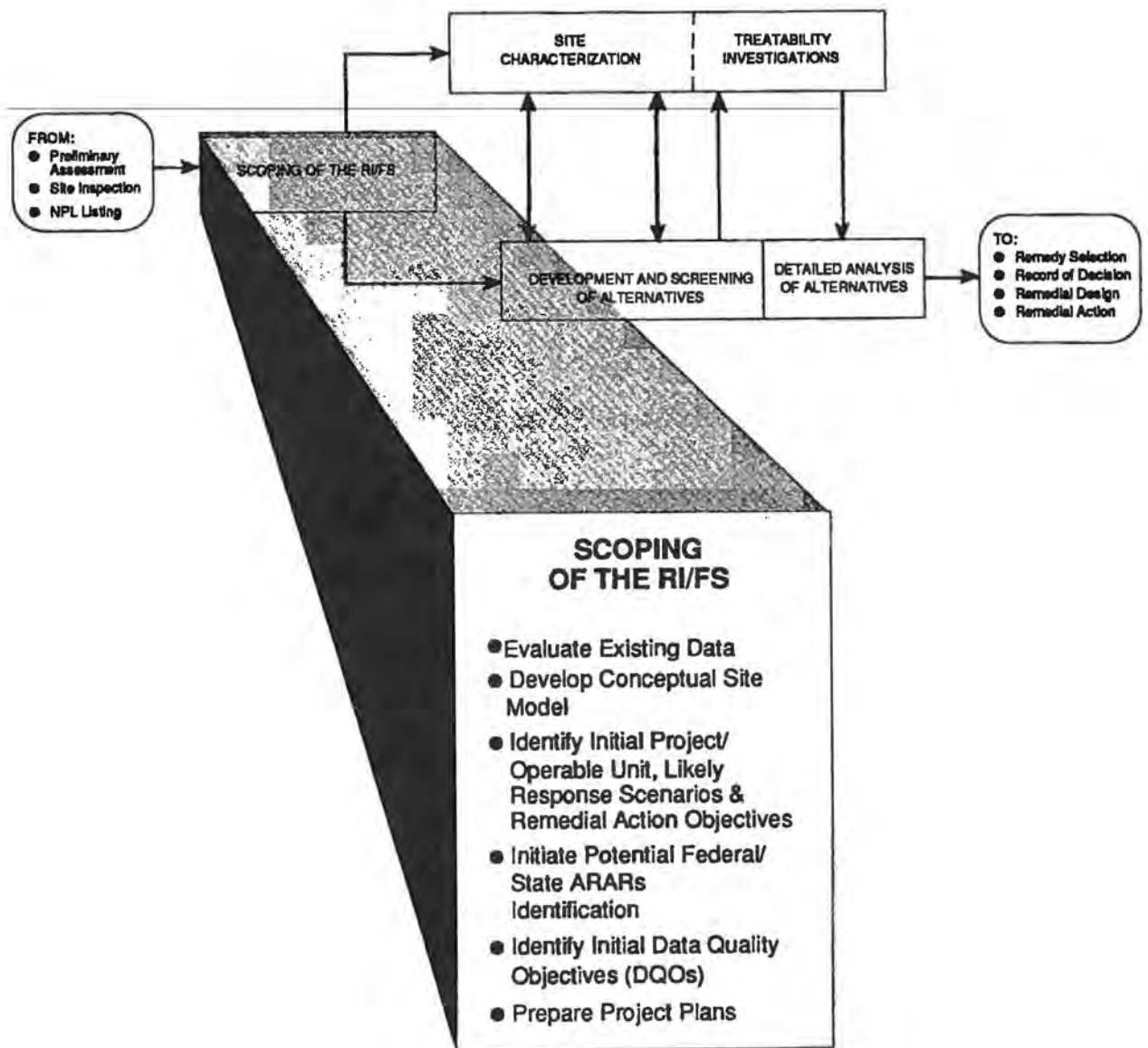
The Remedial Project Manager's (RPM's) role in overseeing an RI/FS involves, to a large extent, ensuring that the work progresses according to the priorities and objectives established during site management and project planning. This role requires planning project scopes early and deriving cost estimates for the specific tasks and activities described in the Statement of Work (SOW).⁵ It is the RPM's responsibility to develop realistic cost

estimates, monitor and control contractor expenditures, and manage changing site conditions within the allocated budget. The RPM facilitates the interactions among EPA staff, State representatives, contractor personnel, PRPs, and the public to ensure that all involved parties are aware of their roles and responsibilities. Throughout the following chapters, and particularly in the discussions of scoping (Chapter 2) and site characterization (Chapter 3), suggestions are provided to guide the RPM in developing approaches for conducting RI/FSs so that high-quality deliverables are produced in a timely and cost-effective manner. Additional suggestions specific to management of RI/FSs may be found in the *Superfund Federal-Lead Remedial Project Management Handbook* (U.S. EPA, December 1986) and *Superfund State-Lead Remedial Project Management Handbook* (U.S. EPA, December 1986). Oversight responsibilities for PRP-lead RI/FSs are outlined in Appendix A of this guidance.

⁵OSWER is developing cost estimating guides and a reference document for use by RPMs that will provide historical averages for the cost of the various RI/FS tasks.

CHAPTER 2

SCOPING OF THE RI/FS



Chapter 2

Scoping the RI/FS

2.1 Introduction

Scoping is the initial planning phase of site remediation and is begun, at least informally, by the lead agency's RPM as part of the funding allocation and planning process. The lead and support agencies should meet and, on the basis of available information, begin to (1) identify the types of actions that may be required to address site problems; (2) identify whether interim actions are necessary or appropriate to mitigate potential threats, prevent further environmental degradation, or rapidly reduce risks significantly, and (3) identify the optimal sequence of site actions and investigative activities.

Once the lead and support agencies initially agree on a general approach for managing the site, the next step is to scope the project(s) and develop specific project plans. Project planning is done to:

- Determine the types of decisions to be made
- Identify the type and quality of data quality objectives (DQOs) needed to support those decisions
- Describe the methods by which the required data will be obtained and analyzed
- Prepare project plans to document methods and procedures

The activities described above relate directly to the establishment of DQOs - statements that specify the type and quality of the data needed to support decisions regarding remedial response activities. The establishment of DQOs is discussed in detail in *Data Quality Objectives for Remedial Response Activities* (U.S. EPA, March 1987, hereafter referred to as the *DQO Guidance*).

The ability to adequately scope a specific project is closely tied to the amount and quality of available information. Therefore, it is important to note that the scope of the project and, to some extent the specific project plans, are developed iteratively (i.e., as new information is acquired or new decisions are made, data requirements are reevaluated and, if appropriate, project plans are modified). In this way, scoping helps

to focus activities and streamline the RI/FS, thereby preventing needless expenditures and loss of time in unnecessary sampling and analyses.

Figure 2-1 shows the key steps in the scoping process.¹

2.2 Project Planning

Once a general site management approach has been agreed upon, planning can begin for the scope of a specific project. The specific activities conducted during project planning include:²

- Meeting with lead agency, support agency, and contractor personnel to discuss site issues and assign responsibilities for RI/FS activities
- Collecting and analyzing existing data to develop a conceptual site model that can be used to assess both the nature and the extent of contamination and to identify potential exposure pathways and potential human health and/or environmental receptors
- Initiating limited field investigations if available data are inadequate to develop a conceptual site model and adequately scope the project
- Identifying preliminary remedial action objectives and likely response actions for the specific project
- Preliminarily identifying the ARARs expected to apply to site characterization and site remediation activities
- Determining data needs and the level of analytical and sampling certainty required for additional data

¹ See Appendix A for a delineation of responsibilities between the lead agency and the PRPs during the scoping process.

² For a PRP-lead RI/FS the PRPs are typically responsible for these activities except for conducting community interviews. This responsibility rests with the lead agency. Specific activities performed by the PRPs during scoping are determined during the negotiation period and should be specified in the agreement between the PRPs and the lead agency.

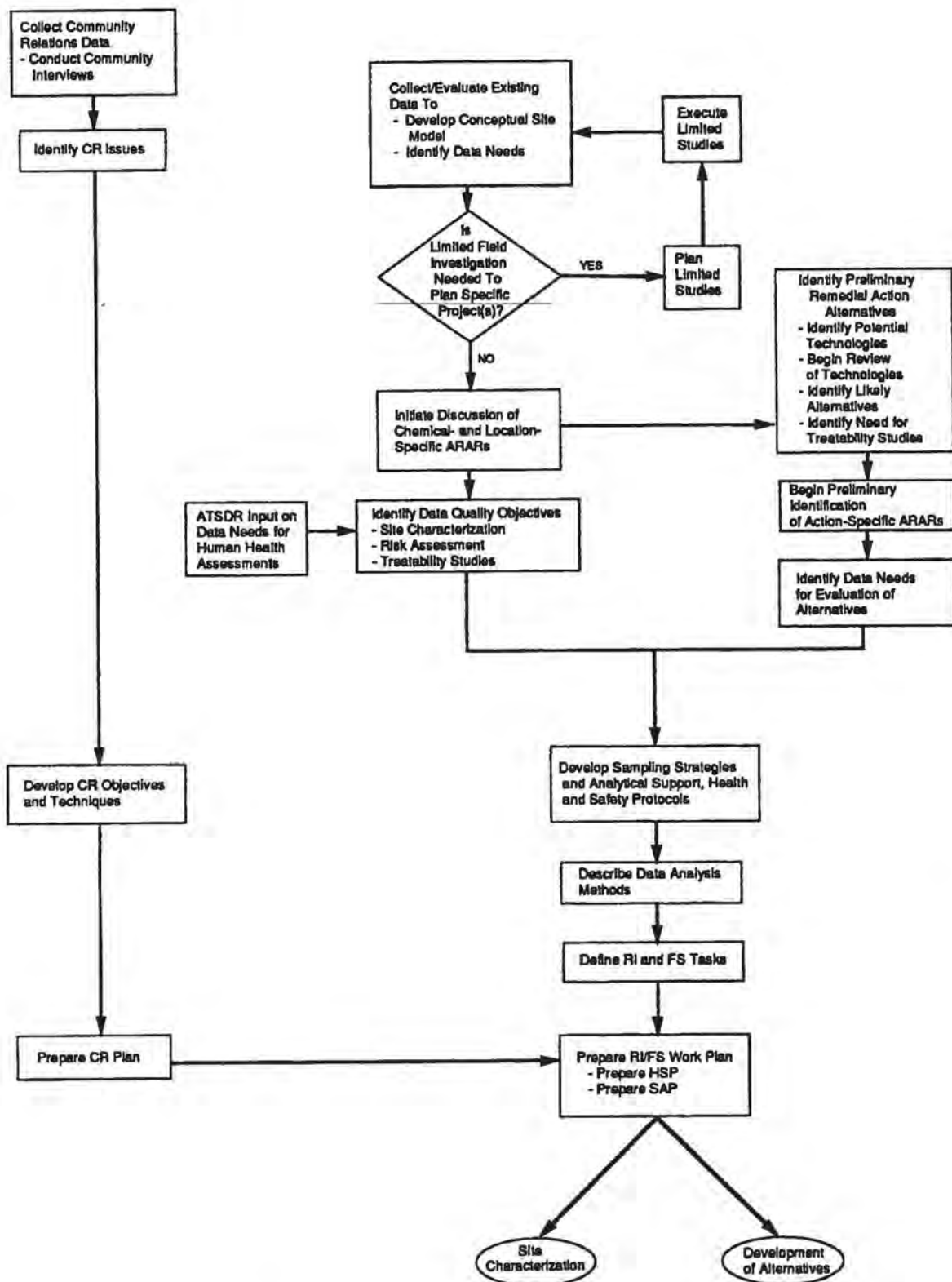


Figure 2-1. Scoping.

if currently available data are inadequate to conduct the FS

- Identifying the need and the schedule for treatability studies to better evaluate potential remedial alternatives
- Designing a data collection program to describe the selection of the sampling approaches and analytical options. (This selection is documented in the SAP, which consists of the FSP and QAPP elements.)
- Developing a work plan that documents the scoping process and presents anticipated future tasks
- Identifying and documenting health and safety protocols required during field investigations and preparing a site health and safety plan
- Conducting community interviews to obtain information that can be used to develop a site-specific community relations plan that documents the objectives and approaches of the community relations program

2.2.1 Conduct Project Meeting

To begin project planning, a meeting should be held involving key management from the lead and support agencies. The purpose of this meeting is to allow key personnel to become involved in initial planning decisions and give them the opportunity to discuss any special concerns that may be associated with the site. Furthermore, this meeting should set a precedent for the involvement of key personnel periodically throughout the project. Additional attendees should include contractor personnel who will be conducting the RI/FS and performing the risk assessment, Natural Resource Trustee representatives, when applicable, and individuals with prior experience at the site [e.g., the field investigation team (FIT)] or other similar sites who may be able to provide additional insight into effective techniques for addressing potential site problems.

2.2.2 Collect and Analyze Existing Data

Before the activities necessary to conduct an RI/FS can be planned, it is important to compile the available data that have previously been collected for a site. These data can be used to determine the additional work that needs to be conducted both in the field and within the community. A thorough search of existing data should help avoid duplication of previous efforts and lead to a remedial investigation that is more focused and, therefore, more efficient in its expenditure of resources.

Information describing hazardous waste sources, migration pathways, and human and environmental receptors for a given site is available from many sources. Some of the more useful sources are listed in Table 2-1. Site investigation (SI) data³ gathered in the hazard ranking process (the process by which a site is listed on the NPL) may be located in files maintained by the EPA Regional offices, the FIT, the technical assistance team (TAT), contractors, and the state.

Data relating to the varieties and quantities of hazardous wastes disposed of at the site should be compiled. The results from any previous sampling events should be summarized in terms of physical and chemical characteristics, contaminants identified, and their respective concentrations. Results of environmental sampling at the site should be summarized, and evidence of soil, ground water, surface water, sediment, air, or biotic contamination should be documented. If available, information on the precision and accuracy of the data should be included.

Records of disposal practices and operating procedures at the site, including historical photographs, can be reviewed to identify locations of waste materials onsite, waste haulers, and waste generators. If specific waste records are absent, waste products that may have been disposed of at the site can be identified through a review of the manufacturing processes of the waste generators.

A summary of existing site-specific and regional information should be compiled to help identify surface, subsurface, atmospheric, and biotic migration pathways. Compiled information should include geology, hydrogeology, hydrology, meteorology, and ecology. Regional information can help to identify background soil, water, and air quality characteristics. Data on human and environmental receptors in the area surrounding the site should be compiled. Demographic and land use information will help identify potential human receptors. Residential, municipal, or industrial wells should be located, and surface water uses should be identified for surrounding areas and areas downstream of the site.

Existing information describing the common flora and fauna of the site and surrounding areas should be collected. The location of any threatened, endangered, or rare species, sensitive environmental areas, or critical habitats on or near the site should be identified. Available results from any previous biological testing should be compiled to document

³The expanded site investigation (ESI) conducted by the pre-remedial program will provide valuable data (e.g., geophysics, surveys, well inventories) and should serve as an important source of information during the scoping process for establishing the hypotheses to be tested concerning the nature and extent of contamination.

Table 2-1. Data Collection Information Sources

Information Source	Waste Sources	Migration Pathways			Receptors
		Subsurface	Surface	Air	
U.S. EPA Files	X	X	X	X	X
U.S. Geological Survey		X	X		
U.S. DOA, Soil Conservation Service ^a		X	X		
U.S. DOA, Agricultural Stabilization and Conservation Service		X	X		
U.S. DOA, Forest Service			X		X
U.S. DOI, Fish and Wildlife Agencies					X
U.S. DOI, Bureau of Reclamation	X	X	X		
U.S. Army Corps of Engineers	X				
Federal Emergency Management Agency ^b			X		
U.S. Census Bureau					X
National Oceanic and Atmospheric Administration				X	
State Environmental Protection or Public Health Agencies	X	X	X	X	X
State Geological Survey		X	X		
State Fish and Wildlife Agencies					X
Local Planning Boards		X	X	X	X
County or City Health Departments	X	X	X	X	X
Town Engineer or Town Hall	X				X
Local Chamber of Commerce	X				X
Local Airport				X	
Local Library		X			X
Local Well Drillers		X			
Sewage Treatment Plants	X	X	X		
Local Water Authorities		X			X
City Fire Departments	X	X	X	X	
Regional Geologic and Hydrologic Publications		X	X		
Court Records of Legal Action	X				
Department of Justice Files	X				
State Attorney General Files	X				
Facility Records	X				
Facility Owners and Employees ^c	X	X			X
Citizens Residing Near Site ^c	X	X	X	X	X
Waste Haulers and Generators ^c	X				
Site Visit Reports	X		X	X	X
Photographs	X		X		X
Preliminary Assessment Report	X	X	X	X	X
Field Investigation Analytical Data	X	X	X	X	
FI/TAT Reports	X	X	X	X	X
Site Inspection Report	X	X	X	X	X
HRS Scoring Package	X	X	X	X	X
EMSL/EPIC (Environmental Monitoring Support Laboratory/ Environmental Photographic Information Center)	X		X		X

^aIncludes county soil survey reports from Soil Conservation Service, U.S. DOA.^bThe Federal Emergency Management Agency publishes floodplain maps.^cInterviews require lead agency concurrence.

any known ecological effect such as acute or chronic toxicity or bioaccumulation in the food chain.

Once the available data have been collected, they are analyzed to (1) establish the physical characteristics of a site to help determine the scope of future sampling efforts; and (2) conceptually model potential exposure pathways and receptors to assist in the preliminary assessment of risk and the initial identification of potential remedial technologies. Each of these uses is discussed below.

2.2.2.1 Establish Physical Characteristics of the Site

The analysis of existing data serves to provide a better understanding of the nature and extent of contamination and aids in the design of remedial investigation tasks. If quality assurance information on existing sampling data is available, it should be reviewed to assess the level of uncertainty associated with the data. This is important to establish whether sampling will be needed to verify or simply supplement existing data. Important factors to consider when reviewing existing data are the comparability of the data (e.g., time of sampling), the analytical methods, the detection limits, the analytical laboratories, and the sample collection and handling methods.⁴

Existing data should be used to develop a site description, which should include location, ownership, topography, geology, land use, waste type, estimates of waste volume, and other pertinent details. The site description should also include a chronology of significant events such as chemical storage and disposal practices, previous site visits, sampling events, regulatory violations, legal actions, and changes in ownership. In addition, information concerning previous cleanup actions, such as removal of containerized waste, is often valuable for determining the characteristics of any wastes or contaminated media remaining at the site. All sources of information or data should be summarized in a technical memorandum or retained for inclusion in the RI report.

2.2.2.2 Develop a Conceptual Site Model

Information on the waste sources, pathways, and receptors at a site is used to develop a conceptual understanding of the site to evaluate potential risks to human health and the environment. The conceptual site model should include known and suspected

sources of contamination, types of contaminants and affected media, known and potential routes of migration, and known or potential human and environmental receptors. This effort, in addition to assisting in identifying locations where sampling is necessary, will also assist in the identification of potential remedial technologies. Additional information for evaluating exposure concerns through the use of a conceptual model is provided in the *DQO Guidance*. An example of a conceptual model is provided in Figure 2-2.

2.2.2.3 Determine the Need for and Implement Limited Additional Studies

If the conceptual understanding of a site is poor and the collection of site-specific data would greatly enhance the scoping effort, a limited field investigation may be undertaken as an interim scoping task prior to developing the work plan.⁵ Normally, the investigation is limited to easily obtainable data, where results can be achieved in a short time. Examples of tasks are as follows:

- Preliminary geophysical investigations
- Residential, industrial, and agricultural well sampling and analysis
- Measurement of well-water level, sampling (only for pre-existing monitoring wells), and analysis
- Limited sampling to determine the need for waste treatability studies
- Air monitoring
- Site mapping
- Preliminary ecological reconnaissance

2.2.3 Develop Preliminary Remedial Action Alternatives

Once the existing site information has been analyzed and a conceptual understanding of the site is obtained, potential remedial action objectives should be identified for each contaminated medium (Chapter 4 presents examples of remedial action objectives) and a preliminary range of remedial action alternatives and associated technologies should be identified. This identification is not meant to be a detailed investigation of alternatives. Rather, it is intended to be a more general classification of potential remedial actions based upon the initially identified potential routes of exposure and associated receptors. The identification of potential technologies at this stage will help ensure that data needed to evaluate them (e.g.,

⁴Regardless of the origin and quality of existing data, they typically are useful in constructing hypotheses concerning the nature and extent of contamination.

⁵The specific procedures for initiating limited field investigation will be dependent on the lead agency's administrative and contractual requirements.

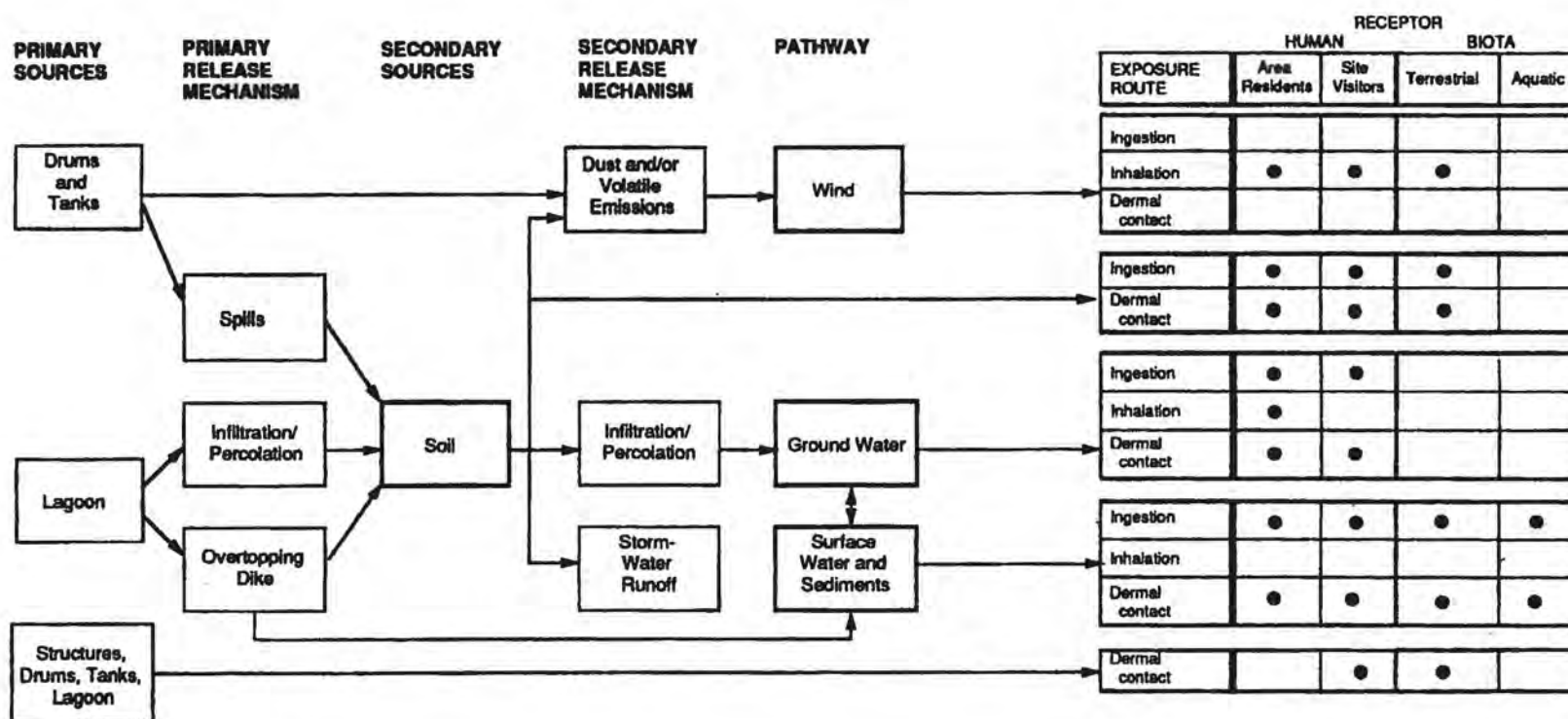


Figure 2-2. Example Conceptual Site Model.

Btu value of wastes to evaluate thermal destruction capabilities) can be collected as early as possible. In addition, the early identification of technologies will allow earlier determinations as to the need for treatability studies.

Technologies that may be appropriate for treating or disposing of wastes should be identified along with sources of literature on the technologies' effectiveness, applications, and cost. Further assistance in the investigation of technologies is provided in the *Technology Screening Guide for Treatment of CERCLA Soils and Sludges* (U.S. EPA, September 1988). Innovative technologies and resource recovery options should be included if they appear feasible.

To the extent practicable, a preliminary list of broadly defined alternatives should be developed that reflects the goal of presenting a range of distinct, viable options to the decision-maker. This list would therefore include as appropriate a range of alternatives in which treatment that significantly reduces the toxicity, mobility, or volume of waste is a principal element; one or more alternatives that involve containment with little or no treatment; and a no-action alternative. The list should be limited to only those alternatives that are relevant and carry some significant potential for being implemented at the site. In this way, the preliminary identification of remedial actions will allow an initial identification of ARARs and will help focus subsequent data-gathering efforts.

Involvement of the various agencies at this time will help in identifying remedial alternatives and scoping field activities. The development of alternatives is described in more detail in Chapter 4 of this document.

2.2.4 Evaluate the Need for Treatability Studies

If remedial actions involving treatment have been identified for a site, then the need for treatability studies should be evaluated as early as possible in the RI/FS process. This is because many treatability studies, especially pilot testing, may take several months or longer to complete. If a lengthy study is required and is not initiated early, completion of the FS may be delayed.

The initial activities of treatability testing include researching other potentially applicable data, designing the study, and procuring vendors and equipment. As appropriate, these activities should occur concurrently with site characterization efforts so that if it is determined that a potential technology is not feasible, planned treatability activities for this technology can be terminated. Chapter 5 provides guidance on scoping treatability studies.

2.2.5 Begin Preliminary Identification of ARARs and To Be Considered (TX) Information

A preliminary identification of potential ARARs and TBC information in the scoping phase can assist in initially identifying remedial alternatives and is useful for initiating communications with the support agency to facilitate the identification of ARARs. Furthermore, early identification of potential ARARs will allow better planning of field activities.* Because of the iterative nature of the RI/FS process, ARAR identification continues throughout the RI/FS as a better understanding is gained of site conditions, site contaminants, and remedial action alternatives.

ARARs may be categorized as chemical-specific requirements that may define acceptable exposure levels and therefore be used in establishing preliminary remediation goals; as location-specific requirements that may set restrictions on activities within specific locations such as floodplains or wetlands; and as action-specific, which may set controls or restrictions for particular treatment and disposal activities related to the management of hazardous wastes. The document, "CERCLA Compliance with Other Laws Manual" (U.S. EPA, Draft, May 1988) contains detailed information on identifying and complying with ARARs.

Potential chemical- and location-specific ARARs are identified on the basis of the compilation and evaluation of existing site data. A preliminary evaluation of potential action-specific ARARs may also be made to assess the feasibility of remedial technologies being considered at this time. In addition to federal ARARs, more stringent state ARARs must also be identified. Other federal and state criteria, advisories, and guidance and local ordinances should also be considered, as appropriate, in the development of remedial action alternatives.

For documentation purposes, a list should be maintained of potential ARARs as they are identified for a site. As the RI/FS progresses, each ARAR will need to be defined. The assistance of the appropriate support agency should be sought in identifying support agency ARARs and confirming their applicability or relevance and appropriateness.

2.2.6 Identify Data Needs

The identification of data needs is the most important part of the scoping process. Data needs are identified by evaluating the existing data and determining what additional data are necessary to characterize the site, develop a better conceptual understanding of the site,

*In addition, compliance with certain environmental statutes (e.g., the National Historic Preservation Act) is simplified by early consultation with the responsible Federal agency.

better define the ARARs, narrow the range of remedial alternatives that have been identified, and support enforcement activities.

The need for additional site data is evaluated relative to meeting the site-specific RI/FS objectives. In general, the RI/FS must obtain data to define source areas of contamination, the potential pathways of migration, and the potential receptors and associated exposure pathways to the extent necessary to:

- Determine whether, or to what extent, a threat to human health or the environment exists
- Develop and evaluate remedial alternatives (including the no-action alternative)
- Support future enforcement or cost-recovery activities

If additional data are needed, the intended uses of the data are identified, strategies for sampling and analyses are developed, DQOs are established, and priorities are assigned according to the importance of the data in meeting the objectives of the RI/FS.

The possible uses of the data include the following:

- Monitoring during implementation
- Health and safety planning
- Site characterization
- Risk assessment
- Evaluating alternatives
- Determining the PRP
- Engineering the design of alternatives

A more complete description of the data uses and their appropriate analytical levels (Figure 2-3) can be found in the DQO Guidance.

Setting priorities for data use helps to determine the highest level of confidence required for each type of data. For example, additional data on soil contamination may be necessary for all the uses listed above but may be of highest priority for risk assessment and evaluation alternatives. Within these two use categories, the evaluation of alternatives may require a much greater level of confidence in the contaminant types and concentrations on site so that cost estimates for treatment can be prepared to meet or approach the goal of a + 50 percent/-30 percent accuracy level. As a result, data needs specifying the level of allowable uncertainty would be set for the evaluation of alternatives use category and would therefore provide an acceptable level of confidence for the remaining data uses.

Sensitivity analyses may be useful in evaluating the acceptable level of uncertainty in data. Critical parameters in any of the use categories can be varied over a probable range of values that were identified in the conceptual site model and that determine the effect on meeting the RI/FS objectives. For example, preliminary treatment costs for contaminated soil can be calculated for various contaminant types and volumes. The sensitivity that contaminant volume and type has on treatment cost can be assessed so that sufficient site characterization data are collected to allow costing of treatment alternatives during the FS using a goal of +50 percent/-30 percent cost accuracy.

In the development of data requirements, time and resource constraints must be balanced with the desired confidence level of the data. The turnaround time necessary for certain analytical procedures may, in some cases, preclude achieving the original level of confidence desired.

Likewise, resource constraints such as the availability of a laboratory, sampling and analysis equipment, and personnel may also influence the determination of data requirements. Because of the high cost of sampling and analysis for contaminants on the hazardous substances list, data acquisition should be focused only on the data quality and quantity necessary and sufficient to meet the RI/FS objectives. It is also important to do any necessary logistical planning once data needs are identified. For example, if it will be necessary to acquire aerial photographs to adequately evaluate a site, it should be noted early in the process so that the acquisition can begin early.

2.2.7 Design a Data Collection Program

Once the level of confidence required for the data is established, strategies for sampling and analysis can be developed. The identification of sampling requirements involves specifying the sampling design; the sampling method; sample numbers, types, and locations; and the level of sampling quality control. Data may be collected in multiple sampling efforts to use resources efficiently, and the level of accuracy may increase as the focus of sampling is narrowed. The determination of analytical requirements involves specifying the most cost-effective analytical method that, together with the sampling methods, will meet the overall data needs for the RI/FS. Data quality requirements specified for sampling and analysis include precision, accuracy, representativeness, completeness, and comparability.

A description of the methods to be used in analyzing data obtained during the RI should be included in a SAP. The level of detail possible in defining the data evaluation tasks will depend on the quality of the site conceptual model. If the site is well understood, data evaluation techniques should be specified and

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS
Site Characterization Monitoring During Implementation	LEVEL I	<ul style="list-style-type: none"> • Total Organic/Inorganic Vapor Detection Using Portable Instruments • Field Test Kits
Site Characterization Evaluation of Alternatives Engineering Design Monitoring During Implementation	LEVEL II	<ul style="list-style-type: none"> • Variety of Organics by GC; Inorganics by AA; XRF • Tentative ID; Analyte-Specific • Detection Limits Vary from Low ppm to Low ppb
Risk Assessment PRP Determination Site Characterization Evaluation of Alternatives Engineering Design Monitoring During Implementation	LEVEL III	<ul style="list-style-type: none"> • Organics/Inorganics Using EPA Procedures other than CLP can be Analyte-Specific • RCRA Characteristic Tests
Risk Assessment PRP Determination Evaluation of Alternatives Engineering Design	LEVEL IV	<ul style="list-style-type: none"> • HSL Organics/Inorganics by GC/MS; AA; ICP • Low ppb Detection Limit
Risk Assessment PRP Determination	LEVEL V	<ul style="list-style-type: none"> • Non-Conventional Parameters • Method-Specific Detection Limits • Modification of Existing Methods • Appendix 8 Parameters

Figure 2-3. Summary of analytical levels appropriate to data uses.

described. This information is especially important if numerical modeling is anticipated. If little existing information is available, the task descriptions may be very general, since it may not be clear which data evaluation techniques will be appropriate. If information is lacking, descriptions of potential

evaluation techniques could be included, and in addition to describing site characterization techniques, methods to be used in the risk assessment also should be described.

2.2.8 Develop a Work Plan

Tasks to be conducted during the RI/FS should be identified and documented in a work plan. Although this work plan will constitute the planning through the completion of the RI/FS, the level of detail with which specific tasks can be described during scoping will depend on the amount and quality of existing data. Therefore, in situations in which additional data are needed to adequately scope the development and evaluation of alternatives, emphasis should be placed on limiting the level of detail used to describe these subsequent tasks and simply noting that the scope of these activities will be refined later in the process. This will reduce the time needed to prepare and review the initial work plan. As the RI/FS process progresses and a better understanding of the site is gained, these task descriptions can be refined. The preliminary descriptions of tasks needed to complete the RI/FS should be documented in the work plan and can be used as a basis for scheduling and estimating the RI/FS budget.

2.2.9 Identify Health and Safety Protocols

Protecting the health and safety of the investigative team and the general public is a major concern during remedial response actions. Workers may be exposed to a variety of hazards including toxic chemicals, biological agents, radioactive materials, heat or other physical stresses, equipment-related accidents, and fires or explosions. The surrounding community may be at increased risk from unanticipated chemical releases, fires, or explosions created by onsite activities. In recognition of these concerns, OSHA has published regulations that stress the importance both of an underlying health and safety program and of site-specific safety planning. The following is a list of documents that contain regulations pertaining to workers at hazardous waste sites:

- *American National Standards, Practices for Respiratory Protection* (American National Standards Institute, 1980)
- *Guidance Manual for Superfund Activities, Volumes 1-9* (National Institute for Occupational Safety and Health, 1985)
- *Occupational Health Guidelines for Chemical Hazards* (National Institute for Occupational Safety and Health, 1981)
- *Safety Manual for Hazardous Waste Site Investigations* (U. S. EPA, 1979)
- *Interim Standard Operating Safety Guides* (U.S. EPA, 1982)
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCC/USEPA, 1985)

- *NIOSH/OSHA Pocket Guide to Chemical Hazards* (National Institute for Occupational Safety and Health, 1978)

- *National Fire Codes* (National Fire Protection Association, 1981)

2.2.10 Conduct Community Interviews

The community relations staff members, which can be either lead agency or contractor personnel and technical staff, should work together during the scoping process so that there is sufficient information to conduct community interviews. Community relations staff members then meet with the identified groups or individuals to gain an understanding of the site's history and the community's involvement with the site from the community's perspective. The lead agency will determine on a site-specific basis the type and number of interviews that need to be conducted to obtain sufficient information to develop an effective community relations plan. The results of the interviews should be made available to all technical staff members to assist in identifying potential waste types and disposal practices, potential pathways of contamination, and potential receptors. On the basis of an understanding of the issues and concerns of the community, the community relations history, and the citizens' indicated preferences for how they would like to be informed concerning site activities, the community relations plan is prepared. Plans should provide opportunities for public input throughout the remedial planning process as appropriate.

2.3 Deliverables and Communication

There are several points during the scoping process when communication is required between the lead agency and its contractor and/or the support agency (see Table 2-2). It is especially important that discussion and information exchange occur if interim actions or limited field investigations are considered necessary. For all RI/FSs, it is desirable for the lead and support agencies and their contractors to review existing data and to agree on the major tasks to be conducted at a site. Specific guidance for the timing and nature of communications between the lead and support agencies is provided in the "Superfund Memorandum of Agreement Guidance" (in preparation).

Deliverables required for all RI/FSs in which field investigations are planned consist of a work plan, an SAP, a health and safety plan (HSP), and a community relations plan (CRP). Although these plans usually are submitted together, each plan may be delivered separately. Each of these plans is described below.

2.3.1 Work Plan

2.3.1.1 Purpose

The work plan documents the decision and evaluation made during the scoping process and presents anticipated future tasks. It also serves as a valuable tool for assigning responsibilities and setting the project's schedule and cost. Information on planning work for lead agency staff may be found in the Superfund Federal-Lead Remedial Project Management Handbook (U.S. EPA, December 1986); and the Superfund State-Lead Remedial Project Management Handbook (U.S. EPA, December 1986). The primary user of the RI/FS work plan is the lead agency for the site (usually either the EPA Region or the appropriate federal or state agency) and the project team that will execute the work. Secondary users of the work plan include other groups or agencies serving in a review capacity, such as EPA Headquarters and local government agencies. The work plan is usually made available for public comment (often in conjunction with a public meeting) and is placed in the Administrative Record.

2.3.1.2 Preparation

The work plan presents the initial evaluation of existing data and background information performed during the scoping process, including the following:

- An analysis and summary of the site background and the physical setting
- An analysis and summary of previous responses
- Presentation of the conceptual site model, including an analysis and summary of the nature and extent of contamination; preliminary assessment of human health and environmental impacts; and the additional data needed to conduct the baseline risk assessment
- Preliminary identification of general response actions and alternatives and the data needed for the evaluation of alternatives

The work plan also defines the scope and objectives of RI/FS activities to the extent possible. The scope of the RI site characterization should be documented in the work plan, with detailed descriptions provided in the SAP. Later tasks will usually be scoped in less detail, pending the acquisition of more complete data about the site.

The initial work plan is prepared prior to the RI site characterization.⁷ Because the RI/FS process is

⁷In enforcement cases, PRPs are typically responsible for the development of the work plan (See Appendix A).

dynamic and iterative, the work plan or supplemental plans, such as the QAPP and the FSP, can be modified during the RI/FS process to incorporate new information and refined project objectives. The work plan should be revised, if necessary, before (1) additional iterations of site characterization activities, and (2) treatability investigations. On federal-lead sites, a work plan revision request (WPRR) is submitted for approval of any significant changes to the budget schedule, or scope. EPA has found technical directive memorandums (TDMs) to be useful for decreasing administrative time when the proposed work plan changes do not affect the total budget or schedule.

2.3.1.3 Work Plan Elements

Five elements (Introduction, Site Background and Physical Setting, Initial Evaluation, Work Plan Rationale, and RI/FS Tasks) typically are included in a work plan. These elements are described in Appendix B.

Among the elements to be included is the specification of RI/FS tasks. For federal-lead sites, 14 standard tasks have been defined to provide consistent reporting and allow more effective monitoring of RI/FS projects. Figure 2-4 shows these tasks and their relationship to the phases of an RI/FS, and detailed task definitions are included in Appendix B. Although RI/FSs that are not federal-lead projects are not required to use these standard tasks, their use provides a valuable project management tool that allows for compilation of historical cost and schedule data to help estimate these tasks during project planning and management.

Project Management Considerations. Project management considerations may be specified in the work plan to define relationships and responsibilities for selected task and project management items. This specification is particularly useful when the lead agency is using extensive contractor assistance. The following project management considerations may be discussed in the work plan:

- Identification of staff (the lead agency's RPM, the PRP's project manager, the contractor, the contractor's site manager, and other team members)
- Coordination among the lead agency, the support agency, the PRPs and the contractors performing the work
- Coordination with other agencies (Typically, the lead agency's RPM is the focus for the coordination of all other agency and private participation in site activities and decisions.)

Table 2-2. Communication and Deliverables During Scoping

Information Needed	Purpose	Potential Methods of Information Exchange
Interim actions (if necessary)	For lead agency and contractor to identify actions that will abate immediate threat to public health or prevent further degradation of the environment; to obtain concurrence of support agency	Meeting Tech Memo Other
Limited field investigations (if necessary)	For lead agency and contractor to improve focus of RI and reduce time and cost; to obtain concurrence of support agency	Meeting Tech Memo Other
Summary of existing data; field studies conducted prior to FS; identification of preliminary remedial action alternatives	For lead agency and contractor to confirm need for field studies; for lead agency and contractor to plan data collection; to obtain support agency review and concurrence	Meeting Tech Memo Other
Documentation of quality assurance (QA) and field sampling procedures	For contractor to obtain lead agency review and approval; for lead agency to obtain support agency review and comment	SAP (FSP,QAPP)
Documentation of health and safety procedures	For contractor to obtain lead agency agreement that OSHA safety requirements are met	Health and safety plan
Documentation of all RI/FS tasks	For contractor to obtain lead agency review and approval; for lead agency to obtain support agency concurrence	Work plan

- Coordination of subcontractors, if any, and description of health and safety requirements and responsibilities
- Interface for federal-lead projects with the Contract Laboratory Program (CLP), if needed, to minimize sampling requirements by use of field screening, to schedule analyses well ahead of sampling trips, and to accurately complete CLP paperwork
- Cost control (including a description of procedures for contractors to report expenditures)
- Schedule control (including a description of schedule tracking methods and procedures for contractors to report activities to the lead agency)
- Identification of potential problems so that the RPM and site manager can develop contingency plans for resolution of problems during the RI/FS
- Evidentiary considerations, if needed, to ensure that project staff members are trained with regard to requirements for admissibility of the work in court

Cost and Key Assumptions. For federal-lead sites, the RI/FS work plan includes a detailed summary of projected labor and expense costs,^a broken down by the 14 tasks listed in Figure 2-3 and described in Appendix B, and a description of the key assumptions required to make such a cost estimate. During

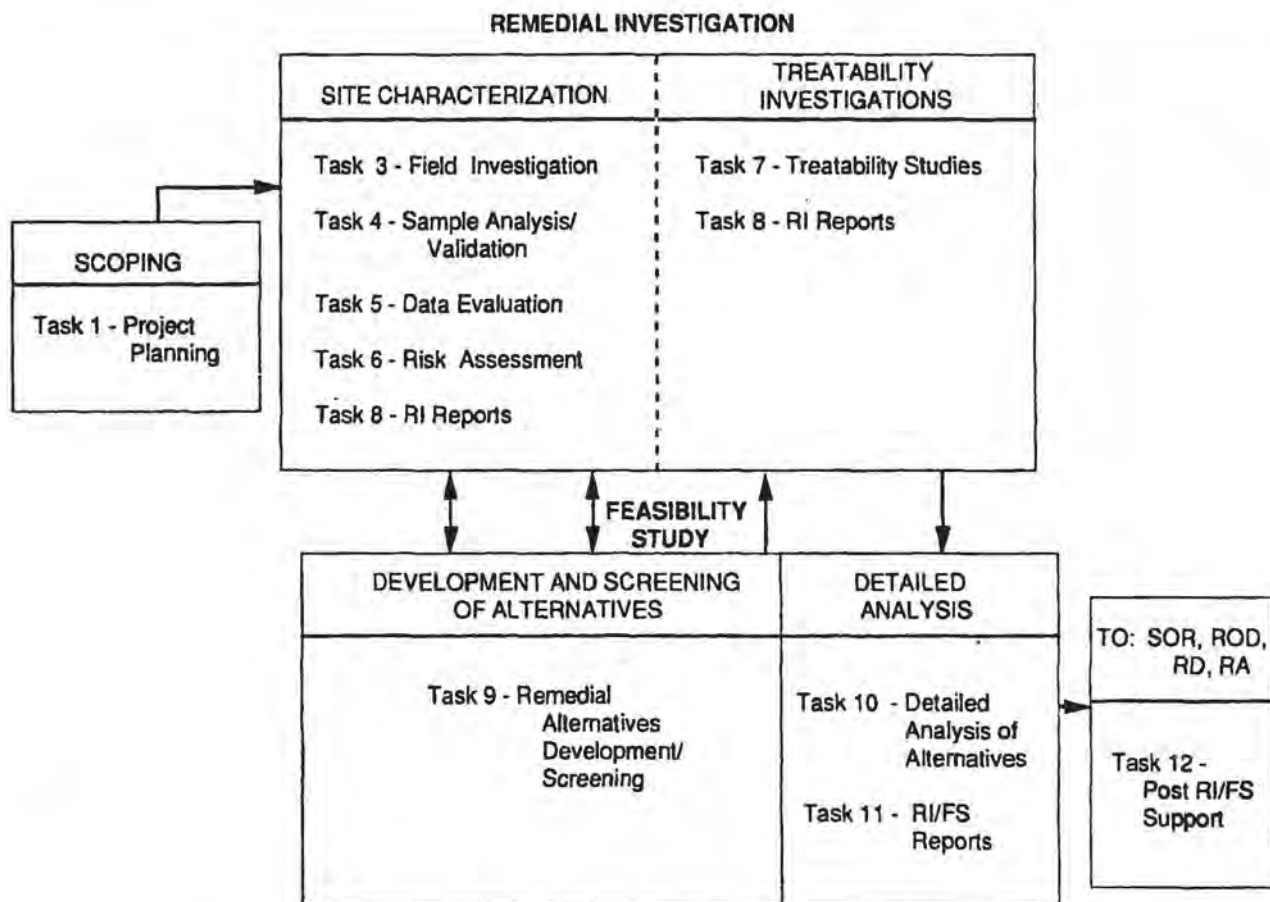
^aThe estimated RI/FS costs prepared by the RPM during the scoping process will form the basis for evaluating costs proposed by the contractor in the work plan and should help facilitate the control of project costs as the RI/FS proceeds. Cost estimates may not be required for State- and PRP-lead RI/FSs.

scoping, more detailed costs typically are provided for the RI site characterization tasks than for later phases of the RI/FS. The less-detailed costs may be refined as field investigations progress and the nature and extent of site contamination is more fully understood.

RI/FS costs vary greatly among sites and are influenced by the following:

- The adequacy of existing data
- The size and complexity of the site
- The level of personnel protection required for onsite workers
- The number and depth of wells required and the types of subsurface conditions where wells will be installed
- The number and types of media sampled
- The number of samples required for each medium
- The need for support of enforcement activities
- The need for bench- or pilot-scale tests

Schedule. The anticipated schedule for the RI/FS is formulated on the basis of the scope of the project, including the identification of key activities and deliverable dates. As with cost, the scheduling of tasks varies among sites.



**RI/FS WORK PLAN
STANDARD TASKS**

TASK	TITLE
1	Project Planning
2	Community Relations *
3	Field Investigation
4	Sample Analysis/ Validation
5	Data Evaluation
6	Risk Assessment
7	Treatability Study/ Pilot Testing
8	Remedial Investigation Reports
9	Remedial Alterna- tives Development/ Screening
10	Detailed Analysis of Alternatives

- | | |
|----|--------------------------------------|
| 11 | Feasibility Study
(RI/FS) Reports |
| 12 | Post RI/FS Support |
| 13 | Enforcement Support * |
| 14 | Miscellaneous
Support * |

* Tasks that can occur in any Phase of the RI/FS

Figure 2-4. Relationship of RI/FS Tasks to Phased RI/FS Approach.

2.3.1.4 Report Format

The work plan should include the elements described in Appendix B. Table 2-3 provides a suggested format.

Table 2-3. Suggested RI/FS Work Plan Format

Executive Summary
1. Introduction
2. Site Background and Setting
3. Initial Evaluation
<ul style="list-style-type: none">• Types and volumes of waste present• Potential pathways of contaminant migration/preliminary public health and environmental impacts• Preliminary identification of operable units• Preliminary identification of response objectives and remedial action alternatives
4. Work Plan Rationale
<ul style="list-style-type: none">• DQO needs• Work plan approach
5. RI/FS Tasks
6. Costs and Key Assumptions
7. Schedule
8. Project Management
<ul style="list-style-type: none">• Staffing• Coordination
9. References
Appendices

2.3.2 Sampling and Analysis Plan (SAP)

2.3.2.1 Purpose

The SAP consists of two parts: (1) a quality assurance project plan (QAPP) that describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve DQOs dictated by the intended use of the data; and (2) the field sampling plan (FSP) that provides guidance for all fieldwork by defining in detail the sampling and data-gathering methods to be used on a project. The FSP should be written so that a field sampling team unfamiliar with the site would be able to gather the samples and field information required. Guidance for the selection and definition of field methods, sampling procedures, and custody can be acquired from the *Compendium of Superfund Field Operations Methods*, which is a compilation of demonstrated field techniques that have been used during remedial response activities at hazardous waste sites (U.S. EPA, September 1987, hereafter referred to as the *Compendium*). To the extent possible, procedures from this *Compendium* should be incorporated by reference. In addition, the FSP and QAPP should be submitted as a single document (although they may be bound separately to facilitate use of the FSP in the field). These efforts will

streamline preparation of the document and reduce the time required for review.

The purpose of the SAP is to ensure that sampling data collection activities will be comparable to and compatible with previous data collection activities performed at the site while providing a mechanism for planning and approving field activities. The plan also serves as a basis for estimating costs of field efforts for inclusion in the work plan.

2.3.2.2 Plan Preparation and Responsibilities

Timing. A SAP is prepared for all field activities. Initial preparation takes place before any field activities begin, but the SAP may be amended or revised several times during the RI site characterization, treatability investigations, or during the FS as the need for field activities is reassessed and rescoped.

Preparation and Review. EPA, the states, PRPs, or the contractors conducting the work should prepare SAPs for all field activities performed. The lead agency's project officer must approve the SAP. Signatures on the title page of the plan usually show completion of reviews and approvals. Environmental sampling should not be initiated until the SAP has received the necessary approvals.⁹ A suggested format for a SAP is listed in Table 2-4.

2.3.2.3 Field Sampling Plan Elements

The FSP consists of the six elements contained in Table 2-4. These elements are described more fully in Appendix B.

2.3.2.4 Quality Assurance Project Plan Elements

The QAPP should contain 14 elements. These elements are listed in Table 2-4 and described in Appendix B. The required information for each of the elements of a QAPP need not be generated each time a QAPP is prepared. Only those aspects of a QAPP that are specific to the site being investigated need to be explicitly described. If site-specific information is already contained in another document (e.g., the FSP) it need only be referenced. Similarly, any information contained in guidance documents such as the *DQO Guidance* should only be referenced and not repeated in the QAPP.

2.3.3 Health and Safety Plan

2.3.3.1 Purpose

Each remedial response plan will vary as to degree of planning, special training, supervision, and protective equipment needed. The health and safety plan

⁹Approval to conduct limited sampling (see Section 2.2.2.3) may be given as part of the interim authorization to prepare the work plans.

Table 2-4. Suggested Format for SAP (FSP and QAPP)

FSP	
	1. Site Background
	2. Sampling Objectives
	3. Sample Location and Frequency
	4. Sample Designation
	5. Sampling Equipment and Procedures
	6. Sample Handling and Analysis
QAPP	
	Title Page
	Table of Contents
	1. Project Description
	2. Project Organization and Responsibilities
	3. QA Objectives for Measurement
	4. Sampling Procedures
	6. Sample Custody
	6. Calibration Procedures
	7. Analytical Procedures
	6. Data Reduction, Validation, and Reporting
	9. Internal Quality Control
	10. Performance and Systems Audits
	11. Preventative Maintenance
	12. Data Assessment Procedures
	13. Corrective Actions
	14. Quality Assurance Reports

prepared to support the field effort must conform to the firm's or agency's health and safety program which must be in compliance with OSHA.

The site health and safety plan should be prepared concurrently with the SAP to identify potential problems early, such as the availability of adequately trained personnel and equipment. OSHA requires that the plan include maps and a detailed site description, results of previous sampling activities, and field reports. The plan preparer should review site information, along with proposed activities, and use professional judgment to identify potentially hazardous operations and exposures and prescribe appropriate protective measures. Appendix B of the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/USEPA,

1985) provides an example of a generic format for a site health and safety plan that could be tailored to the needs of a specific employer or site.

2.3.3.2 Elements of the Health and Safety Plan

Each site health and safety plan should include, at a minimum, the 11 elements described in Appendix B of this guidance. The specific information required in a site health and safety plan is listed in 29 CFR 1910.120.

2.3.3.3 Site Briefings and Inspections

The OSHA regulation requires that safety briefings be held "prior to initiating any site activity and at such other times as necessary to ensure that employees are apprised of the site safety plan and that it is being followed."

The final component of site health and safety planning or informational programs is site auditing to evaluate compliance with and effectiveness of the site health and safety plan. The site health and safety officer or that person's designee should carry out the inspections.

2.3.4 Community Relations Plan

2.3.4.1 Purpose

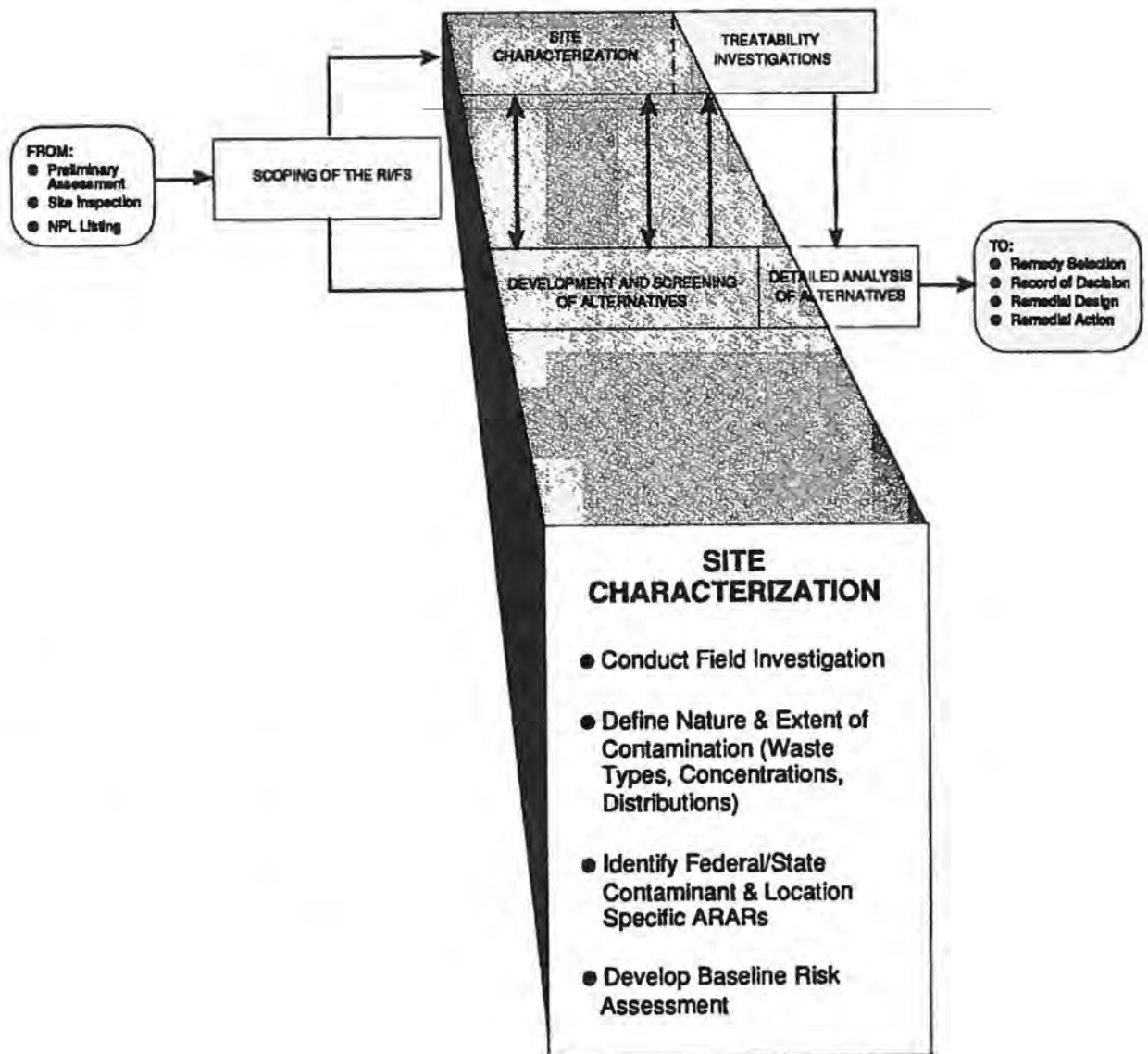
The CRP documents the community relations history and the issues of community concern. It should describe the techniques that will be needed to achieve the objectives of the program. The plan is used by community relations staff, but it should also be used by federal and state agency technical staff members when planning technical work at the site.

2.3.4.2 Community Relations Plan Elements

Report preparation methods, the elements contained in a CRP, and a recommended format are included in *Community Relations in Superfund: A Handbook* (U.S. EPA, Interim, June 1988). This handbook also includes useful examples of community relations plans.

CHAPTER 3

SITE CHARACTERIZATION



Chapter 3

Site Characterization

3.1 Introduction

During site characterization, the sampling and analysis plan (SAP), developed during project planning, is implemented and field data are collected and analyzed to determine to what extent a site poses a threat to human health or the environment. The major components of site characterization are presented in Figure 3-1 and include:

- Conducting field investigations as appropriate
- Analyzing field samples in the laboratory
- Evaluating results of data analysis to characterize the site and develop a baseline risk assessment
- Determining if data are sufficient for developing and evaluating potential remedial alternatives

Because information on a site can be limited prior to conducting an RI, it may be desirable to conduct two or more iterative field investigations so that sampling efforts can be better focused. Therefore, rescoping may occur at several points in the RI/FS process. During site characterization, rescoping and additional sampling may occur if the results of field screening or laboratory analyses show that site conditions are significantly different than originally believed. In addition, once the analytical results of samples have been received (either from a laboratory or a mobile lab) and the data evaluated, it must be decided whether further sampling is needed to assess site risks and support the evaluation of potential remedial alternatives in the FS. At this time, it is usually apparent whether the data needs identified during project planning were adequate and whether those needs were satisfied by the first round of field sampling. As discussed in Chapter 4, there are also points during the FS when the need for additional field studies may be identified. These additional studies, if needed, can be conducted during subsequent site characterization activities.

This chapter provides detailed descriptions of those activities that may be required during the RI site characterization. As discussed earlier, the complexity and extent of potential risks posed by Superfund sites is highly variable. Therefore, the lead and support

agencies will have to decide on a site-specific basis which of the activities described in this chapter must be conducted to adequately characterize the problem(s) and help in the evaluation of remedial alternatives.

3.2 Field Investigation Methods

Field investigation methods used in RIs are selected to meet the data needs established in the scoping process and outlined in the work plan and SAP. This section provides an overview of the type of site characterization data that may be required and the investigative methods used in obtaining these data. The following sections describe methods for (1) implementing field activities, (2) investigating site physical characteristics, (3) defining the sources of contamination, and (4) evaluating the nature and extent of contamination. Specific information on the field investigation methods described below is contained in the Compendium. Sections of the Compendium that apply to particular types of field investigations are shown in Table 3-1.

3.2.1 Implement Field Activities

In addition to developing the SAP, fieldwork support activities, such as the following, are often necessary before beginning fieldwork:

- Assure that access to the site and any other areas to be investigated has been obtained
- Procure subcontractors such as drillers, excavators, surveyors, and geophysicists
- Procure equipment (personal protective ensembles, air monitoring devices, sampling equipment, decontamination apparatus) and supplies (disposables, tape, notebook, etc.)
- Coordinate with analytical laboratories, including sample scheduling, sample bottle acquisition reporting, chain-of-custody records, and procurement of close support laboratories or other in-field analytical capabilities
- Procure onsite facilities for office and laboratory space, decontamination equipment, and vehicle

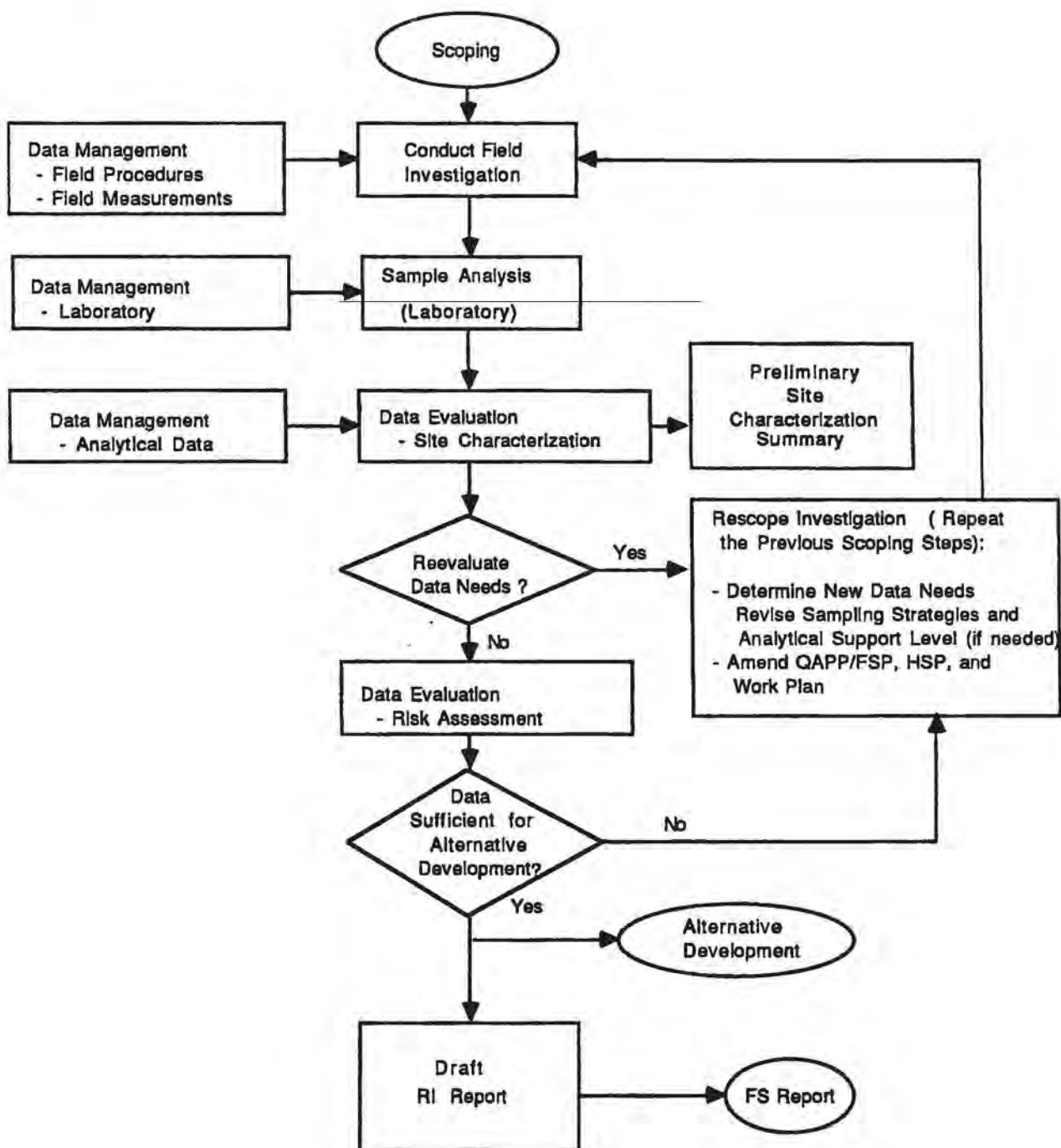


Figure 3-1. Major components of site characterization.

maintenance and repair, and sample storage, as well as onsite water, electric, telephone, and sanitary utilities

- Provide for storage or disposal of contaminated material (e.g., decontamination solutions, disposable equipment, drilling muds and cuttings,

Table 3-1. Relationship Among Site Characterization Tasks and the *Compendium*

Tasks	Applicable Sections and Subsections of the <i>Compendium</i> of Superfund Field Operations Methods
Field Investigation	7, 11, 15
Air	
Biota ¹	12
Close support laboratories	5.2, 7, 15
RI-derived waste disposal	3.2, 5.2.6.4, 8.1.6.3
Soil gas	
Support	3, 17, 16, 19, 20
Well logging	8.1, 8.3
Mapping and survey	14
Geophysical	8.4
Well installation	8.1, 8.5
Ground water	8.5
Soil	8.1, 8.2, 8.3
Source testing	7, 13, 15
Surface water	10
Sample analysis	
Fieldwork, close support laboratory	5.2, 15
Data validations	16
Sample management	4, 5, 6
Data evaluation	16

¹OSWER is currently developing a Superfund environmental evaluation manual that will provide guidance for conducting ecological investigations.

well-development fluids, well-purging water, and spill-contaminated materials)

Since procurement activities can take up to several months, they should be initiated as early as possible so as not to affect the overall RI/FS schedule. Schedule impacts should also be avoided by structuring contracts, where possible, such that there is no need to reprocur services for subsequent site characterization activities. This may be accomplished using contract options that are exercised only in the event that additional services or facilities are required (e.g., basic ordering agreements for well drilling).

Mobile labs or labs located near the site can often reduce the time necessary for completing RI activities. If such quick-turnaround analysis is available, it can be used to determine the location and type of subsequent sampling that must take place to more completely characterize the site. This may also alleviate the need to reprocur subcontractors, and significantly accelerate the completion of the RI. If such analytical techniques are to be employed, the

work plan and SAP should allow for decisions on subsequent activities to be made in the field with oral approval from key management personnel.

3.2.2 Investigate Site Physical Characteristics

Data on the physical characteristics of the site and surrounding areas should be collected to the extent necessary to define potential transport pathways and receptor populations and to provide sufficient engineering data for development and screening of remedial action alternatives. Information normally needed can be categorized as surface features (including natural and artificial features), geology, soils, surface water hydrology, hydrogeology, meteorology, human populations, land use(s) and ecology.

3.2.2.1 Surface Features

Surface features may include facility dimensions and locations (buildings, tanks, piping, etc.), surface disposal areas, fencing, property lines and utility lines, roadways and railways, drainage ditches, leachate springs, surface-water bodies, vegetation, topography, residences, and commercial buildings. Features such as these are usually identified for possible contaminant migration and the location of potentially affected receptors. Investigation of surface features should not be limited to those that are onsite, but should include significant offsite features as well. Other facilities in the area that are potential contributors to contamination should also be identified.

A history of surface features at the site can be developed from existing data. As discussed in Chapter 2, the data may include historical photographs, past topographic surveys, operational records, and information obtained during interviews with owners, operators, local residents, and local regulatory agencies. Review of historical photographs is sometimes the most valuable of these methods. Aerial photographs are often available from such sources as the Environmental Monitoring Support Laboratory, Las Vegas (EMSL-LV), the Environmental Photographic Interpretation Center (EPIC), and the Soil Conservation Service of the U.S. Department of Agriculture.

Existing surface features may be described using aerial photography, surveying and mapping, and site inspection. Inspection of the site and the surrounding areas is normally augmented with photographs. Section 14 of the *Compendium* presents additional details on land surveying, aerial photography, and mapping.

3.2.2.2 Geology

Geology may control or affect the following aspects of a site:

- The depths, locations, and extents of water-bearing units or aquifers
- The release of contaminants and their subsequent movement
- The engineering geologic aspects of site exploration and remediation

The investigation of site geology should be tailored to ensure the identification of those features that will affect the fate and transport of contaminants. For example, an understanding of site geology is less important at a site at which release of contaminants occurs by volatilization to the atmosphere than at a site at which contaminants are moving toward the water table.

To understand the geology of a site, one must determine the geology of bedrock and of unconsolidated overburden and soil deposits. Table 3-2 summarizes specific information on overburden and bedrock geology that may be needed. The degrees to which overburden and bedrock geology must be understood depend on the geologic character of the site area, as well as the physical characteristics of the site itself. An understanding of regional geologic characteristics is useful in determining which aspect of site geology may have the greatest influence on the fate and transport of contaminants and the use of potential remedial technologies.

In general, an investigation of site geology should include the following steps:

- Determination of regional geology from available information
- Reconnaissance mapping of the area, which may include geophysical investigations onsite
- Subsurface explorations

The degree to which these steps are undertaken will be determined by the degree to which the need to evaluate geologic aspects of the site dictates the investigations needed in the RI/FS. These investigation methods are described in detail in Section 8 of the *Compendium* and summarized in Table 3-2.

3.2.2.3 Soils and the Vadose Zone

Properties of surface soils and the vadose zone influence the type and rate of contaminant movement to the subsurface and subsequently to the water

table. Contaminants that can move through the surface soil and into the vadose zone may move directly to the water table or they may be partially or fully retained within the vadose zone to act as continual sources of ground-water contamination. Engineering, physical, and chemical properties of soil and vadose zone materials can be measured in the field or in the laboratory. Table 3-3 summarizes typical methods for soil and vadose zone investigations.

3.2.2.4 Surface-Water Hydrology

Surface-water features may include erosion patterns and surface-water bodies such as ditches, streams, ponds, and lakes. The transport of contaminants in surface-water bodies is largely controlled by flow, which in streams is a function of the gradient, geometry, and coefficient of friction. A description of how flow is measured can be found in Section 10 of the *Compendium*. Contaminants have three possible modes of transport: (1) sorption onto the sediment carried by the flow, (2) transport as suspended solid, and (3) transport as a solute (dissolved). The transport of dissolved contaminants, which move the fastest, can be determined by characterizing the flow of the surface water and the contaminant dispersion. Sediment and suspended solid transport involve other processes such as deposition and resuspension. Table 3-4 presents the surface-water information that may be required for characterizing sites.

If potential pathways include surface water, necessary data about impoundments may include (1) physical dimensions such as depth, area, and volume; (2) residence time; and (3) current direction and rates. As with impoundments, the direction and velocity of lake currents are often highly variable and, as a result, are difficult to measure and accurately predict. Site mapping will provide much of this information. Measurement techniques (which are specified in Section 10, Surface Hydrology, of the *Compendium*) include the use of current meters and drogue tracking.

3.2.2.5 Hydrogeology

Determination of site hydrogeology involves identifying geologic characteristics, hydraulic properties, and ground-water use, as defined in Tables 3-5 and 3-6 and described in Section 8 of the *Compendium*. The determination of site geology and hydrogeology can often be incorporated into a single investigative program. Regional hydrogeologic conditions can be determined from existing information; site-specific hydrogeologic conditions can be determined using subsurface explorations, well installations, and field testing of hydraulic properties. Table 3-7 summarizes the typical data

Table 3-2. Summary of Site Geology Information

Information Needed	Purpose of Rationale	
<ul style="list-style-type: none"> ● Geology of unconsolidated overburden and soil deposits <ul style="list-style-type: none"> - Thickness and areal extent of units - Lithology; mineralogy - Particle size and sorting; porosity ● Geology of bedrock <ul style="list-style-type: none"> - Type of bedrock (igneous, metamorphic, sedimentary) - Lithology; petrology - Structure (folds, faults) - Discontinuities (joints, fractures, bedding planes, foliation) - Unusual features such as igneous intrusive bodies (dikes), lava tubes, solution cavities in limestone (karst) 	<p>For both unconsolidated and bedrock geology:</p> <ul style="list-style-type: none"> ● Evaluate the influence of geology on water-bearing units and aquifers ● Evaluate the influence of geology on release and movement of contaminants ● Obtain information on the engineering geologic aspects of site remediation 	<p>For both unconsolidated and bedrock geology:</p> <ul style="list-style-type: none"> ● Determination of regional geology from available information <ul style="list-style-type: none"> - Published reports (geologic reports, ground-water reports, soil survey reports) - State geologic maps - USGS topographic quadrangle maps - Descriptions of regional geology from previous reports of site investigations ● Site reconnaissance mapping <ul style="list-style-type: none"> - Field mapping of surficial soil and overburden units, bedrock outcrops, surface water drainage, springs, and seeps - Analyses of aerial photography or other remote imagery - Surface geophysics ● Subsurface explorations <ul style="list-style-type: none"> - Test borings or core borings (with or without sampling) - Test pits and trenches - Description and logging of subsurface geologic materials - Sample collection for laboratory analyses of physical properties and mineral content - Borehole geophysics

collected and available analytical methodologies used during a hydrogeologic investigation.

3.2.2.6 Meteorology

Meteorological data are often required to characterize the atmospheric transport of contaminants for risk assessment determinations and provide real-time monitoring for health and safety issues. Representative offsite and site-specific data may be obtained using sampling methods outlined in Section 11, "Meteorology and Air Quality," of the Compendium. This publication also discusses data requirements for using refined air quality modeling and applicable models. Table 3-8 summarizes atmospheric investigations.

3.2.2.7 Human Populations and Land Use

Information should be collected to identify, enumerate, and characterize human populations potentially exposed to contaminants released from a site. For a potentially exposed population, information should be collected on population size and location. Special consideration may be given to identifying potentially sensitive subpopulations (e.g., pregnant

women, infants) to better facilitate the characterization of risks posed by contaminants exhibiting specific effects (e.g., mutagens, teratogens). Census and other survey data may be used to identify and describe the population potentially exposed to contaminated media. Information may also be available from U.S. Geological Survey maps, land use plans, zoning maps, and regional planning authorities.

Data describing the type and extent of human contact with contaminated media also are needed,¹ including:

- Location and use of surface waters
 - Drinking water intakes and distribution
 - Recreational (swimming, fishing) areas
 - Connection between surface-water bodies
- Local use of ground water as a drinking-water source
 - Number and location of wells

¹ In some situations, information may be available from the ATSDR if they previously have conducted health consultations.

Table 3-3. Summary of Soil and Vadose Zone Information

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary
Soil Characteristics:			
Type, holding capacity, temperature, biological activity, engineering properties	Estimate the effect of the properties on infiltration and retardation of leachates and the release of gaseous contaminants	Reports and maps by Federal and county agencies, Soil Conservation Service (SCS) publications	Borehole sampling, laboratory measurements (ASTM methods), water budget methods, instantaneous rate method, seepage meters, infiltrometers, test basins
Soil Chemistry Characteristics:			
Solubility, ion speciation, adsorption coefficients, leachability, cation exchange capacity, mineral partition coefficients, chemical and sorptive properties	Predict contaminant movement through soils and availability of contaminants to biological systems	Existing scientific literature	Chemical analysis, column experiments, leaching tests
Vadose Zone Characteristics:			
Permeability, variability, porosity, moisture content, chemical characteristics, extent of contamination	o Estimate flux in the vadose zone	Existing literature	Water budget with soil moisture accounting Draining profile methods Measurement of hydraulic gradients Estimates assuming unit hydraulic gradient Flow meters Methods based on estimating or measuring hydraulic conductivity, using: o Laboratory parameters o Relationships between hydraulic conductivity and grain size o Catalog of hydraulic properties o Field measurements of hydraulic conductivity using single or multiple wells
	o Estimate velocity in the vadose zone	Existing literature	o Tracers o Calculations using flux values o Calculations using long-term infiltration data
	o Evaluate pollutant movement in the vadose zone	Existing literature	Four-probe electrical method Electrical conductivity probe Salinity sensors Solids sampling followed by laboratory extraction of pore water Solids sampling for organic and microbial constituents Suction lysimeters Sampling perched ground water

Table 3-4. Summary of Surface-Water Information

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary
Drainage Patterns:			
o Overland flow, topography, channel flow pattern, tributary relationships, soil erosions, and sediment transport and deposition	Determine if overland or channel flow can result in onsite or offsite flow and if patterns form contaminant pathways	Topographic maps, site inspection, and soil conservation services	Aerial mapping and ground survey
Surface-Water Bodies:			
o Flow, stream widths and depths, channel elevations, flooding tendencies, and physical dimensions of surface-water impoundments	Determine volume and velocity, transport times, dilution potential, and potential spread of contamination	Public agency data and atlases; catalogs, maps, and handbooks for background data	Aerial mapping and ground survey
o Structures	Effect of manmade structures on contaminant transport and migration	Public agency maps and records and ground survey	
o Surface-water/ground-water relationships	Predict contaminant pathways for interceptive remedial actions	Public agency reports and surveys	Water level measurements and modeling
Surface-Water Quality:			
o pH, temperature, total suspended solids, suspended sediment, salinity, and specific contaminant concentrations	Provide capacity of water to carry contaminants and water/sediment partitioning	Public agency computerized data files, handbooks, and open literature	Sampling and analysis

Table 3-5. Aspects of Site Hydrogeology

• Geologic aspects
- Type of water-bearing unit or aquifer (overburden, bedrock)
- Thickness, areal extent of water-bearing units and aquifers
- Type of porosity (primary, such as intergranular pore space, or secondary, such as bedrock discontinuities or solution cavities)
- Presence or absence of impermeable units or confining layers
- Depths to water table; thickness of vadose zone
• Hydraulic aspects
- Hydraulic properties of water-bearing unit or aquifer (hydraulic conductivity, transmissivity, storativity, porosity, dispersivity)
- Pressure conditions (confined, unconfined, leaky confined)
- Ground-water flow directions (hydraulic gradients, both horizontal and vertical), volumes (specific discharge), rate (average linear velocity)
- Recharge and discharge areas
- Ground-water or surface water interactions; areas of ground-water discharge to surface water
- Seasonal variations of ground-water conditions
• Ground-water use aspects
- Identify existing or potential aquifers
- Determine existing near-site use of ground water

Table 3-6. Features of Ground-Water Systems

■ Components of Ground-Water Systems
- Unconfined aquifers
- Confining beds
- Confined aquifers
- Presence and arrangement of components
■ Water-bearing openings of the dominant aquifer
- Primary openings
- Secondary openings
■ Storage and transmission characteristics of the dominant aquifer
- Porosity
- Transmissivity
• Recharge and discharge conditions of the dominant aquifer
• Human use or access to the site and adjacent areas
- Residential
- Commercial
- Recreational use
• Location of population with respect to site
- Proximity
- Prevailing wind direction

Information on expected land use, as well as current land use, is desirable. Available population growth projections, land use plans, and zoning maps can help develop expected exposure scenarios. This information may be obtained from zoning boards, the census bureau, regional planning agencies, and other local governmental entities.

3.2.2.8 Ecological Investigations

Biological and ecological information collected for use in the baseline risk assessment aids in the evaluation of impacts to the environment and also helps to identify potential effects with regard to the implementation of remedial actions. The information should include a general identification of the flora and fauna associated in and around the site with particular emphasis placed on identifying sensitive environments, especially endangered species and their habitats and those species consumed by humans or found in human food chains. Examples of sensitive environments include wetlands, flood plains, wildlife breeding areas, wildlife refuges, and specially designated areas such as wild and scenic rivers or parks.

Depending on the specific circumstances, data may be needed for species that have key ecological functions in particular ecosystems, such as primary or secondary producers, decomposers, scavengers, predators, or species that occupy key positions in the food chains of humans or other species. Bioaccumulation data on food chain organisms, such as aquatic invertebrates and fish, may be particularly important to both environmental risk and human risk assessment.² Data gathered through biological assessment techniques (e.g., bioassays and/or field monitoring) may be useful in situations where there are complex mixtures, incomplete toxicity information, and/or unidentified or unmeasured compounds. The Natural Resources Trustees for the site should be contacted to determine if other ecological data are available that may be relevant to the investigation. A summary of environmental information that may be needed and potential collection methods is provided in Table 3-9.

Prudent judgment on the part of the site managers is required to ensure that only relevant data that will aid in evaluating potential ecological risk and/or potential remedial actions are collected. Because human health risks may be more substantial than ecological risks, and the mitigative actions taken to alleviate risks to human health are often sufficient to mitigate potential ecological risks as well, extensive ecological investigations may not be required for many sites.

²Ecological Information collected to aid in the assessment of risk to humans exposed through food chain contamination should be used in accordance with the *Superfund Public Health Evaluation Manual* (U.S. EPA, October 1986).

Table 3-7. Summary of Ground-Water Information

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary*
Ground-Water Occurrence:			
• Aquifer boundaries and locations	Define flow limits and degree of aquifer confinement	Existing literature, water resource atlases	Installation of wells and piezometers (single level or multilevel)
• Aquifer ability to transmit water	Determine potential quantities and rates for treatment options	Pumping and injection tests of monitor wells	Ground-water level measurements (over time to monitor seasonal variations) Instrument survey of wells for calculation of ground-water elevations Borehole and surface geophysics
Ground-Water Movement:			
• Direction of flow	Identify most likely pathways of contaminant migration	Existing hydrologic literature	Water level measurements in monitor wells Testing of hydraulic properties using slug tests, tracer tests, and pump tests (short- or long-duration, single or multiple well) Elevation contours of water table or potentiometric surface Analytical calculations of flow directions and rates Computer generated simulations of ground-water flow and contaminant transport (using analytical or numerical methods)
• Rate of flow	Determine maximum potential migration rate and dispersion of contaminants	Existing hydrologic literature	Generation of site water balance Hydraulic gradient, permeability, and effective porosity from water level contours, pump test results, and laboratory analyses
Ground-Water Recharge/Discharge:			
• Location of recharge/discharge areas	Determine interception points for withdrawal options or areas of capping	Existing site data, hydrologic literature, site inspection	Comparison of water levels in observation wells, piezometers, lakes, and streams Field mapping of ground-water recharge areas (losing streams, interstream areas) and ground-water discharge to surface water (gaining streams, seeps, and springs)
• Rate	Determine variability of loading to treatment options	Existing literature	Water-balance calculations aided by geology and soil data
Ground-Water Quality:			
• pH, total dissolved solids, salinity, specific contaminant concentrations	Determine exposure via ground water; define contaminant plume for evaluation of interception methods	Existing site data	Analysis of ground-water samples from observation wells, geophysics

*May be appropriate if detailed information is required or if it is the only method due to a lack of published data.

Table 3-8. Summary of Atmospheric Information

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary
Local Climate:	Define recharge, aeolian erosion, evaporation potential, effect of weather patterns on remedial actions, area of deposition of particulates	National Climate Center (NCC) of National Oceanic and Atmospheric Administration; local weather bureaus	Onsite measurements and observations
o Precipitation			
o Temperature			
o Wind speed and direction			
o Presence of inversion layers			
Weather Extremes:	Determine effect of weather extremes on selection and timing of remedial actions, and extremes of depositional areas	NCC; State emergency planning offices; Federal Emergency Management Agency flood insurance studies	
o storms			
o Floods			
o Winds			
Release Characteristics:	Determine dispersion characteristics of release	Information from source facility, weather services, air monitoring services	Onsite measurements
o Direction and speed of plume movement			
o Rate, amount, temperature of release			
o Relative densities			

The use of a review committee comprised of individuals experienced in conducting ecological investigations is encouraged to provide design, planning, and oversight for these investigations and to follow through to the selection of an environmentally sound remedy. Section 12 of the *Compendium* addresses environmental information that may be needed and potential collection methods.

3.2.3 Define Sources of Contamination

Sources of contamination are often hazardous substances contained in drums, tanks, surface impoundments, waste piles, and landfills. In a practical sense, heavily contaminated media (such as soils) may also be considered sources of contamination, especially if the original source (such as a leaking tank) is no longer present on the site or is no longer releasing contaminants.

Source characterization involves the collection of data describing (1) facility characteristics that help to identify the source location, potential releases, and engineering characteristics that are important in the evaluation of remedial actions; (2) the waste characteristics, such as the type and quantity of contaminants that may be contained in or released to the environment; and (3) the physical or chemical characteristics of hazardous wastes present in the source. Key source characterization data are summarized in Table 3-10.

The location and type of existing containment should be determined for all known sources. In addition, where the hazardous substance remains in containment vessels, the integrity of the containment structure should be determined so that the potential for release and its magnitude can be evaluated. This determination is especially important for buried drums or tanks, because corrosion may be rapid. These data, as well as the data identified in Table 3-10, may be obtained largely through site inspections, mapping, remote sensing, and sampling and analysis. The waste type should be determined for each source. If available waste manifests or facility records can be reviewed, the industrial processes that resulted in generation of the waste should be determined and the types of contaminants usually present in the process waste identified. Often, sources are sampled and analyzed for contaminants found on the Target Compound List (TCL) (formerly the Hazardous Substances List) or other lists such as those developed for RCRA³. Quantities of wastes may be estimated for each waste type either from verifiable inventories of containerized wastes, from sampling and analysis, or from physical dimensions of the source. Section 13 of the *Compendium* and

Characterization of Hazardous Waste Sites - A Methods Manual, Volume II (U.S. EPA, April 1985) describe methods suitable for sampling and analysis.

It may be possible to determine the location and extent of sources and the variation of materials within a waste deposit by nonchemical analysis. Methodologies for this determination, which are described in Section 8 of the *Compendium*, include geophysical surveys. A variety of survey techniques (e.g., ground-penetrating radar, electrical resistivity, electromagnetic induction, magnetometry, and seismic profiling), can effectively detect and map the location and extent of buried waste deposits. Aerial photography and infrared imagery can aid in defining sources through interpretation of the ecological effects that result from stressed biota. However, all of these geophysical methods are nonspecific, and subsequent sampling of the sources will probably be required to provide the data for evaluation of source control measures at the site.

3.2.4 Determine the Nature and Extent of Contamination

The final objective of the field investigations is to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented by the site and the appropriate type(s) of remedial response. This process involves using the information on source location and physical site data (e.g., ground-water flow directions, over land flow patterns) to give a preliminary estimate of the locations of contaminants that may have migrated. An iterative monitoring program is then implemented so that, by using increasingly accurate analytical techniques, the locations and concentrations of contaminants that have migrated into the environment can be documented.

The sampling and analysis approach that should be used is discussed in Section 4.5.1 of the *DQO Guidance*. In short, the approach consists of, where appropriate, initially taking a large number of samples using field screening type techniques and then, based on the results of these samples, taking additional samples - to be analyzed more rigorously - from those locations that showed the highest concentrations in the previous round of sampling. The final step is to document the extent of contamination using an analytical level that yields data quality that is sufficient for the risk assessment and the subsequent analysis and selection of remedial alternatives.

At hazardous waste sites the nature and extent of contamination may be of concern in five media: ground water, soil, surface water, sediments, and air. The methodologies for conducting sampling and analysis for each of these media are discussed below. More detailed descriptions of the investigation

³Guidance on determining whether wastes are RCRA-listed or characteristic wastes can be found in the *CERCLA Compliance with Other Laws Manual* (U.S. EPA, May 1988).

Table 3-9. Summary of Ecological Information

<u>Information Needed for Public Health Evaluation</u>	<u>Purpose or Rationale</u>	<u>Collection Methods</u>	
		<u>Primary</u>	<u>Secondary</u>
Land Use Characteristics	Determine if terrestrial environment could result in human exposure, e.g., through hunting or use of agricultural land	Ground and aerial survey maps; site survey	Ground and aerial surveys
Water Use Characteristics	Determine if aquatic environment could result in human exposure, e.g., through fishing or other recreational water activities	Water resource agency reports; site surveys	
<u>Information Needed for Environmental Evaluation</u>			
Ecosystem Components and Characteristics	Determine potentially affected ecosystems; determine presence of endangered species	Records of area plants and animal surveys, survey of plants and animals on or near a site; survey of a site or area photographs	Ground surveys and sample collection
Critical Habitats	Determine the area on or near a site to be protected during remediation	Records of site environment	Ground and water surveys
Biocontamination	Determine observable impact of contaminants	Records of site environment	Sampling and analysis

Table 3-10. Summary of Source Information

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary
Facility Characteristics:			
o Source location	Locate above-ground and subsurface contaminant sources	Site inspection facility records, archival photos	Remote sensing, sampling, and analysis
o Type of waste/chemical containment	Determine potential remedies for releases	Site inspection	Remote sensing
o Integrity of waste/chemical containment	Determine probability of release and timing of response	Site inspection	Sampling and analysis; nondestructive testing
o Drainage control	Determine probability of release to surface water	Site inspection; topographic maps	
o Engineered structures	Identify possible conduits for migration or interference with remedial actions	Site inspection; facility records	Remote sensing
o Site security	Determine potential for exposure by direct contact; may dictate response	Site inspection	
o Known discharge points (outfalls, stacks)	Determine points of accidental or intentional discharge	Site inspection; facility records	

Table 3-10. Continued

Information Needed	Purpose or Rationale	Collection Methods	
		Primary	Secondary
o Mapping and surveying	Locate existing structures and obstructions for alternatives evaluation, site features, and topography	Existing maps (USGS, county, land development)	Remote sensing; surveying
Waste Characteristics:			
o Type	Determine contaminants for exposure assessments and for treatment options	Site inspection; waste manifests	Sampling and analysis
o Quantities	Determine magnitude of potential releases	Site inspection	Sampling and analysis; geophysical surveys
o Chemical and physical properties	Determine environmental mobility, persistence, and effects; determine parameters for development and evaluation of alternatives	Site inspection, handbooks, CHEMTREC/OHMTADS, Chemical Information Service (CIS), and facility records	Sampling and analysis
o Concentrations	Determine quantities and concentrations potentially released to environmental pathways	Site inspection	Sampling and analysis

process can be found in the *DQO Guidance* and the *Compendium*.

3.2.4.1 Ground Water

The nature and extent of ground-water contamination should be evaluated both horizontally and vertically. On the basis of geologic and hydrogeologic investigations, it should be determined if contamination of an aquifer(s) is possible and if such contamination could potentially affect human or environmental receptors. Following this, a ground-water monitoring program may need to be implemented, concentrating the placement of wells in the direction of ground-water flow, in aquifers subject to contamination, and in places where they would indicate an existing or future threat to receptor populations. However, because of the uncertainties associated with subsurface migration, identifying background levels, and determining if there is a contribution from other sources, sampling should also be conducted in the area perceived to be upgradient from the contaminant source.

Because of the significant investment necessary to drill new wells and the resulting limited number of samples, neither Level I nor field-screening techniques are appropriate for analysis of ground water, other than to possibly better define chemical analysis parameters. Geophysical techniques can be useful in identifying the location of plumes and thereby assisting in the location of monitoring wells. However, geophysical techniques are subject to influences from external factors and are not appropriate at all sites. Therefore, care must be taken in employing these methods, and their results should always be confirmed with analytical sampling. Specific guidance on conducting ground water sampling investigations and response activities can be found in the *Compendium*, the *DQO Guidance*, and the "Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites" (U.S. EPA, Draft, August 1988).

3.2.4.2 Soil

As with ground-water sampling, the intent of soil sampling is to characterize and estimate the limits of existing soil contamination. Field-screening techniques (e.g., soil gas analysis, mobile laboratories for target compounds) can be useful for directing soil sampling into areas of greatest contamination or "hot spots." If existing information provides no basis for predicting where hot spots might occur, sampling locations can be chosen in a grid pattern of appropriate size such that investigators can be confident that areas of high concentration have been located. Often, especially if soil has been contaminated as a result of overland flow of contaminants from defined sources, sampling can be

concentrated in those areas that, either through topography or evidence such as drainage channels, it is most likely that contaminants have been deposited. As with ground water, soil contamination should be documented in both vertical and horizontal directions. This approach will help determine both areas of contamination and background concentrations. Soils to be analyzed usually can be obtained by hand, allowing many samples to be taken and initially analyzed with instruments such as a photoionization detector. Results of field screening can then be used to determine which samples should be further analyzed using more rigorous methods.

3.2.4.3 Surface Water

Leachate from contaminant sources or discharge of contaminated ground water can result in the contamination of surface waters. Surface-water sampling locations should be chosen at the perceived location(s) of contaminant entry to the surface water and downstream, as far as necessary, to document the extent of contamination. As with soil, the relative ease of obtaining samples allows many samples to be taken and analyzed using field screening methods, a subset of which can be chosen for more rigorous analysis.

Contamination of surface water is sometimes the result of an incidental release of contaminants such as the overflowing or breach of a surface impoundment. In these cases, it is not likely that routine surface water sampling will show contamination that has or may occur. Therefore, to document whether such releases occur, sampling should be conducted during or following periods of heavy rainfall when possible.

3.2.4.4 Sediments

A potentially more serious and common problem associated with surface water is the contamination of sediments. Whereas contamination in surface water tends to become diluted or transformed as it travels downstream, contaminants deposited in sediments tend to remain in place. It is therefore important to monitor for sediment contamination if it is suspected that surface water has been contaminated.

The choice of sampling locations for sediments is similar to the criteria applied to surface-water sampling. Field-screening techniques can be useful in defining areas of contamination. However, it should be noted that sediment contamination often consists of inorganics and/or nonvolatile organics for which field screening techniques are not as applicable. Therefore, in designing a sampling program, consideration of the contaminants of concern is very important.

3.2.4.5 Air

Volatilization of organics and emissions of airborne particulates can be a concern at hazardous waste sites. For sites at which it appears that air emissions are a problem (e.g., surface impoundments containing volatile organics, landfills at which there is evidence of methane gas production and migration), an air emissions monitoring program should be undertaken. A field-screening program is recommended to determine if there is an air pollution problem, both for volatile organics and fugitive dust emissions. Because of the highly variable nature of air emissions from hazardous waste sites, consideration of meteorological conditions at the time of sampling is essential for the proper documentation of potential air pollution.

3.2.5 Additional Site Characterization

In some situations, additional site information may be required to refine our understanding of the site and better evaluate specific remedial alternatives. Examples include:

- Better delineation of contaminated areas and depths of contamination so that quantities of contaminated media to be processed can be calculated more accurately
- Characteristics of the media that would affect the feasibility of the remedial alternative, such as soil permeability for soil-vapor extraction
- Pertinent site characteristics not discovered earlier in the initial site characterization effort

Before additional site characterization is initiated, the QAPP/FSP should be reviewed and modified as appropriate to guide the collection of additional site data. In addition, site data collected and evaluated as part of the initial RI site characterization should be reviewed and compared to the data needs identified for conducting the detailed analysis of alternatives. Reviewing data needs during the preplanning step is also useful in predicting the necessary number of samples and types of analyses required.

3.3 Laboratory Analyses

Data that will be used as the basis for decision-making requires that the analysis of samples in laboratories meets specific QA/QC requirements. To meet these requirements, federal- or state-lead site investigations have the option of using mobile laboratories; the CLP, which is established by EPA; or a non-CLP laboratory that meets the DQOs of the site investigation.⁴

⁴The type of laboratory analyses that will be utilized for a PRP-lead RI/FS may also include any of those listed above, if approved by the RPM (See Appendix A).

The CLP provides analytical services through a nationwide network of laboratories under contract to EPA. The lead agency chooses whether or not to use a CLP laboratory on the basis of available CLP capacity and the analytical requirements that meet the DQOs. If the CLP is not used, a laboratory may be procured using standard bidding procedures.

Under the CLP, the majority of analytical needs are met through standardized laboratory services provided by Routine Analytical Services (RAS). The RAS program currently provides laboratory services for the analysis of organics and inorganics in water or solid samples. Other specialized types of analysis not yet provided by standardized laboratory contracts may be scheduled on an as-needed basis under the special analytical services (SAS) program. The SAS program is designed to complement the RAS program by providing the capability for specialized or custom analytical requirements. If an analytical need is not ordinarily provided by routine analytical services (FWS), a specific subcontract can be awarded under the SAS program to meet a particular requirement.

The decision whether to use mobile laboratories or a CLP or non-CLP laboratory should be based on several factors including the analytical services required, the number of samples to be analyzed, the desired turnaround time, and the anticipated turnaround time of the laboratory at the time samples are to be sent. Mobile or non-CLP laboratories located close to the site may be the best choice when fast turnaround of analytical results is required to meet specific sampling objectives or would result in a significant reduction of the overall RI/FS schedule. To facilitate the most efficient completion of the RI, mobile or non-CLP laboratories can be used to initially document the nature and extent of contamination. Selected duplicate samples can be sent to CLP laboratories to confirm and validate the analytical results from the mobile or non-CLP laboratories. This process assists in the timely completion of the RI and the initiation of FS activities, while still ensuring that legally defensible data are available for decision-making and potential cost-recovery actions.

If a non-CLP laboratory is used, analytical protocols need to be specified in the bid packages sent to laboratories that are under consideration. For federal-lead sites, laboratories receiving invitations to bid have usually been approved by the EPA Regional QA representative. For state-lead sites at which non-CLP laboratories are used, the laboratory usually subcontracts with the prime contractor when the project is initiated.

Section 5 of the Compendium presents the details of procedures for the use of CLP laboratories and non-CLP laboratories. The User's Guide to the Contract

Laboratory Program (U.S. EPA, December 1966) also presents procedures for use of the CLP.

3.4 Data Analyses

Analyses of the data collected should focus on the development or refinement of the conceptual site model by presenting and analyzing data on source characteristics, the nature and extent of contamination, the contaminated transport pathways and fate, and the effects on human health and the environment. Data collection and analysis for the site characterization is complete when the DQOs that were developed in scoping (including any revisions during the RI) are met, when the need (or lack thereof) for remedial actions is documented, and when the data necessary for the development and evaluation of remedial alternatives have been obtained. The results of the RI typically are presented as an analysis of site characteristics and the risk associated with such characteristics (i.e., the baseline risk assessment).

3.4.1 Site Characteristics

The evaluation of site characteristics should focus on the current extent of contamination and estimating the travel time to, and predicting contaminant concentrations at, potential exposure points. Data should be analyzed to describe (1) the site physical characteristics, (2) the source characteristics, (3) the nature and extent of contamination, and (4) the important contaminant fate and transport mechanisms.

3.4.1.1 Site Physical Characteristics

Data on site physical characteristics should be analyzed to describe the environmental setting at the site, including important surface features, soils, geology, hydrology, meteorology, and ecology. This analysis should emphasize factors important in determining contaminant fate and transport for those exposure pathways of concern. For example, if migration of contamination in ground water is of concern, these factors may include the properties of the unsaturated zone, the rate and direction of flow in the aquifer(s), and the extent of subsurface systems.

3.4.1.2 Source Characteristics

Data on source characteristics should be analyzed to describe the source location; the type and integrity of any existing waste containment; and the types, quantities, chemical and physical properties, and concentrations of hazardous substances found. The actual and potential magnitude of releases from the source and the mobility and persistence of source contaminants should be evaluated.

3.4.1.3 The Nature and Extent of Contamination

An analysis of data collected concerning the study area should be performed to describe contaminant concentration levels found in environmental media in the study area. Analyses that are important to the subsequent risk assessment and subsequent development of remedial alternatives include the horizontal and vertical extent of contamination in soil, ground water, surface water, sediment, air, biota, and facilities.⁵ Spatial and temporal trends in contamination may be important in evaluating transport pathways. Data should be arranged in tabular or graphical form for clarity. Figure 3-2 shows an example of how the extent of soil and ground-water contamination can be represented in terms of excess lifetime cancer risk. Similar figures can be prepared showing concentrations rather than risk values.

3.4.1.4 Contaminant Fate and Transport

Results of the site physical characteristics, source characteristics, and extent of contamination analyses are combined in the analyses of contaminant fate and transport. If information on the contaminant release is available, the observed extent of contamination may be used in assessing the transport pathway's rate of migration and the fate of contaminants over the period between release and monitoring. Contaminant fate and transport may also be estimated on the basis of site physical characteristics and source characteristics.

Either analysis may use analytical or numerical modeling. While field data generally best define the extent of contamination, models can interpolate among and extrapolate from isolated field samples and can interpret field data to create a more detailed description. Models also can aid the data reduction process by providing the user with a structure for organizing and analyzing field data.

Models applicable to site characterization can be grouped according to their relative accuracy and their ability to depict site conditions. Simplified models (e.g., analytical and semianalytical models) can quantitatively estimate site conditions with relatively low accuracy and resolution. Typically, they provide order-of-magnitude estimates and require that simplified assumptions be made regarding site conditions and chemical characteristics.

More detailed numerical models (e.g., numerical computer codes) provide greater accuracy and resolution because they are capable of representing

⁵Cross-media contamination should be considered (e.g., potential for contaminated soils to act as a source for ground-water contamination due to leaching from the soil).

spatial variations in site characteristics and irregular geometries commonly found at actual sites. These models can also represent the actual configuration and effects of remedial actions on site conditions. Detailed mathematical models are sometimes appropriate for investigations in which detailed information on contaminant fate and transport is required.

Models also are useful for screening alternative remedial actions and may be used for a detailed analysis of alternatives. Deciding whether analytical or numerical models should be used and selecting appropriate models for either the remedial investigation or the feasibility study can be difficult. Modeling may not be needed if site conditions are well understood and if the potential effectiveness of different remedial actions can be easily evaluated. In selecting and applying models, it is important to remember that a model is an artificial representation of a physical system and is only one way of characterizing and assessing a site. A model cannot replace, nor can it be more accurate than, the actual site data. Additional information on determining contaminant fate and transport is provided in the "Superfund Exposure Assessment Manual" (U.S. EPA, April 1988).

3.4.2 Baseline Risk Assessment

3.4.2.1 General Information

Baseline risk assessments provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action. They provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions. The baseline risk assessment will also be used to support a finding of imminent and substantial endangerment if such a finding is required as part of an enforcement action. Detailed guidance on evaluating potential human health impacts as part of this baseline assessment is provided in the *Superfund Public Health Evaluation Manual (SPHEM)* (U.S. EPA, October 1986).^{*} Guidance for evaluating ecological risks is currently under development within OSWER.

In general, the objectives of a baseline risk assessment may be attained by identifying and characterizing the following:

Toxicity and levels of hazardous substances present in relevant media (e.g., air, ground water, soil, surface water, sediment, and biota)

^{*}This guidance is currently undergoing revision.

- Environmental fate and transport mechanisms within specific environmental media such as physical, chemical, and biological degradation processes and hydrogeological conditions
- Potential human and environmental receptors
- Potential exposure routes and extent of actual or expected exposure
- Extent of expected impact or threat; and the likelihood of such impact or threat occurring (i.e., risk characterization)
- Level(s) of uncertainty associated with the above items

The level of effort required to conduct a baseline risk assessment depends largely on the complexity of the site. The goal is to gather sufficient information to adequately and accurately characterize the potential risk from a site, while at the same time conduct this assessment as efficiently as possible. Use of the conceptual site model developed and refined previously will help focus investigation efforts and, therefore, streamline this effort. Factors that may affect the level of effort required include:


- The number, concentration, and types of chemicals present
- Areal extent of contamination
- The quality and quantity of available monitoring data
- The number and complexity of exposure pathways (including the complexity of release sources and transport media)
- The required precision of sample analyses, which in turn depends on site conditions such as the extent of contaminant migration and the proximity, characteristics, and size of potentially exposed population(s)
- The availability of appropriate standards and/or toxicity data


3.4.2.2 Components of the Baseline Risk Assessment

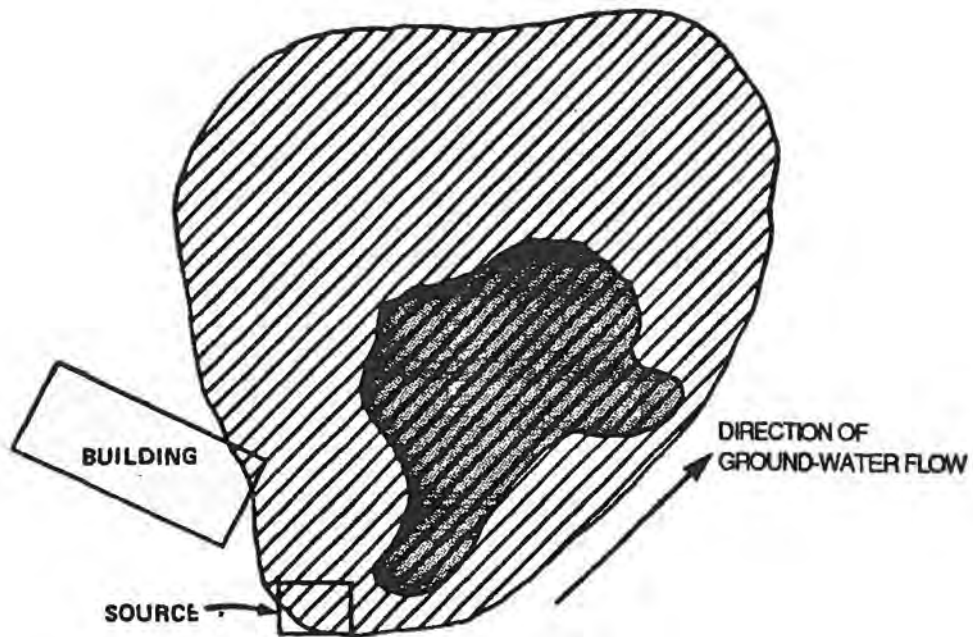
The risk assessment process can be divided into four components:

- Contaminant identification
- Exposure assessment
- Toxicity assessment

LEGEND*

 Soil Area Exceeding 10^{-6} Lifetime Cancer Risk

 Ground Water Exceeding 10^{-6} Lifetime Cancer Risk



*NOTE: 1. Site-specific features should be shown as appropriate (e.g., actual or potential ground-water users).

2. Contamination can be represented by concentrations in addition to risk levels.

Figure 3-2. Representation of the areal extent of contamination.

● Risk characterization

Figure 3-3 illustrates the risk assessment process and its four components. A brief overview of each component follows.

Contaminant Identification. The objective of contaminant identification is to screen the information that is available on hazardous substances or wastes present at the site and to identify contaminants of concern to focus subsequent efforts in the risk assessment process. Contaminants of concern may be selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are presently in or potentially may move into critical exposure pathways (e.g., drinking water supply).

It may be useful for some sites to select "indicator chemicals" as part of this process.⁷ Indicator chemicals are chosen to represent the most toxic, persistent, and/or mobile substances among those identified that are likely to significantly contribute to the overall risk posed by the site. In some instances, an indicator chemical may be selected for the purpose of representing a "class" of chemicals (e.g., TCE to represent all volatiles). Although the use of indicator chemicals serves to focus and streamline the assessment on those chemicals that are likely to be of greatest concern, a final check will need to be made during remedy selection and the remedial action phase to ensure that the waste management strategy being implemented addresses risks posed by the range of contaminants found at the site.

Exposure Assessment The objectives of an exposure assessment are to identify actual or potential exposure pathways, to characterize the potentially exposed populations, and to determine the extent of the exposure. Detailed guidance on conducting exposure assessments is provided in the *Superfund Exposure Assessment Manual* (U.S. EPA, April 1988), and is briefly discussed below.

Identifying potential exposure pathways helps to conceptualize how contaminants may migrate from a source to an existing or potential point of contact. An exposure pathway may be viewed as consisting of four elements: (1) A source and mechanism of chemical release to the environment; (2) An environmental transport medium (e.g., air, ground water) for the released chemical; (3) A point of potential contact with the contaminated medium (referred to as the exposure point); and (4) An exposure route (e.g., inhalation, ingestion) at the exposure point.

⁷The methodology for identifying indicator chemicals for assessing human health risks is described in the *Superfund Public Health Evaluation Manual* (U.S. EPA, October 1986).

The analysis of the contaminant source and how contaminants may be released involves characterizing the contaminants of concern at the site and determining the quantities and concentrations of contaminants released to environmental media. Figure 3-4 presents a conceptual example identifying actual and potential exposure pathways.

Once the source(s) and release mechanisms have been identified, an analysis of the environmental fate and transport of the contaminants is conducted. This analysis considers the potential environmental transport (e.g., ground-water migration, airborne transport); transformation (e.g., biodegradation, hydrolysis, and photolysis); and transfer mechanisms (e.g., sorption, volatilization) to provide information on the potential magnitude and extent of environmental contamination. Next, the actual or potential exposure points for receptors are identified. The focus of this effort should be on those locations where actual contact with the contaminants of concern will occur or is likely to occur. Last, potential exposure routes that describe the potential uptake mechanism (e.g., ingestion, inhalation, etc.) once a receptor comes into contact with contaminants in a specific environmental medium are identified and described. Environmental media that may need to be considered include air, ground water, surface water, soil and sediment, and food sources. Detailed procedures for estimating and calculating rates of exposure are described in detail in the *Superfund Exposure Assessment Manual*.

After the exposure pathway analysis is completed, the potential for exposure should be assessed. Information on the frequency, mode, and magnitude of exposure(s) should be gathered. These data are then assessed to yield a value that represents the amount of contaminated media contacted per day. This analysis should include not only identification of current exposures but also exposures that may occur in the future if no action is taken at the site. Because the frequency mode and magnitude of human exposures will vary based on the primary use of the area (e.g., residential, industrial, or recreational), the expected use of the area in the future should be evaluated.⁸ The purpose of this analysis is to provide decision-makers with an understanding of both the current risks and potential future risks if no action is taken. Therefore, as part of this evaluation, a reasonable maximum exposure scenario should be developed, which reflects the type(s) and extent of exposures that could occur based on the likely or expected use of the site (or surrounding areas) in the

⁸This evaluation does not require an extensive analysis of demographic trends and a statistically measurable confidence level for the prediction of future development, only that the likely use (based on past and current trends, zoning restrictions, etc.) be evaluated.

future.¹⁹ The reasonable maximum exposure scenario is presented to the decision-maker so that possible implications of decisions regarding how to best manage uncertainties can be factored into the risk management remedy selection.

The final step in the exposure assessment is to integrate the information and develop a qualitative and/or quantitative estimate of the expected exposure level(s) resulting from the actual or potential release of contaminants from the site.

Toxicity Assessment. Toxicity assessment, as part of the Super-fund baseline risk assessment process, considers (1) the types of adverse health or environmental effects associated with individual and multiple chemical exposures; (2) the relationship between magnitude of exposures and adverse effects; and (3) related uncertainties such as the weight of evidence for a chemical's potential carcinogenicity in humans. Detailed guidance for conducting toxicity assessments is provided in the *SPHEM*.

Typically, the Super-fund risk assessment process relies heavily on existing toxicity information and does not involve the development of new data on toxicity or dose-response relationships. Available information on many chemicals is already evaluated and summarized by various EPA program offices or cross-Agency work groups in health and environmental effects assessment documents. These documents or profiles will generally provide sufficient toxicity and dose-response information to allow both qualitative and quantitative estimates of risks associated with many chemicals found at Superfund sites. These documents often estimate carcinogen exposures associated with specific lifetime cancer risks (e.g., risk-specific doses or RSDs), and systemic toxicant exposures that are not likely to present appreciable risk of significant adverse effects to human populations over a lifetime (e.g., Reference Doses or RfDs).

Risk Characterization. In the final component of the risk assessment process, a characterization of the potential risks of adverse health or environmental effects for each of the exposure scenarios derived in the exposure assessment, is developed and summarized. Estimates of risks are obtained by integrating information developed during the exposure and toxicity assessments to characterize the potential or actual risk, including carcinogenic risks, noncarcinogenic risks, and environmental risks. The final analysis should include a summary of the risks associated with a site including each projected

exposure route for contaminants of concern and the distribution of risk across various sectors of the population. In addition, such factors as the weight-of-evidence associated with toxicity information, and any uncertainties associated with exposure assumptions should be discussed.

Characterization of the environmental risks involves identifying the potential exposures to the surrounding ecological receptors and evaluating the potential effects associated with such exposure(s). Important factors to consider include disruptive effects to populations (both plant and animal) and the extent of perturbations to the ecological community.

The results of the baseline risk assessment may indicate that the site poses little or no threat to human health or the environment. In such situations, the FS should be either scaled down as appropriate to that site and its potential hazard, or eliminated altogether. The results of the RI and the baseline risk assessment will therefore serve as the primary means of documenting a no-action decision. If it is decided that the scope of the FS will be less than what is presented in this guidance or eliminated altogether, the lead agency should document this decision and receive the concurrence of the support agency.

3.4.3 Evaluate Data Needs

As data are collected and a better understanding of the site and the risks that it poses are obtained, the preliminary remedial action alternatives developed during scoping should be reviewed and refined. The available data should be evaluated to determine if they are sufficient to develop remedial alternatives. If they are not, additional data gathering will be required. When sufficient data are available, remedial response objectives with respect to the contaminants of concern, the areas and volumes of contaminated media, and existing and potential exposure routes and receptors of concern can be developed as part of the FS.

3.5 Data Management Procedures

An RI may generate an extensive amount of information, the quality and validity of which must be consistently well documented because this information will be used to support remedy selection decisions and any legal or cost recovery actions. Therefore, field sampling and analytical procedures for the acquisition and compilation of field and laboratory data are subject to data management procedures.¹⁹ The discussion on data management

¹⁹ Additional guidance on developing reasonable maximum exposure scenarios will be provided in the upcoming revision of the *SPHEM*.

¹⁹ DQOs will govern the data management procedures used, and the QAPP/FSP will identify both field-collected and analytical data. Information to be recorded should include sampling information, recording procedures, sample management, and QC concerns.

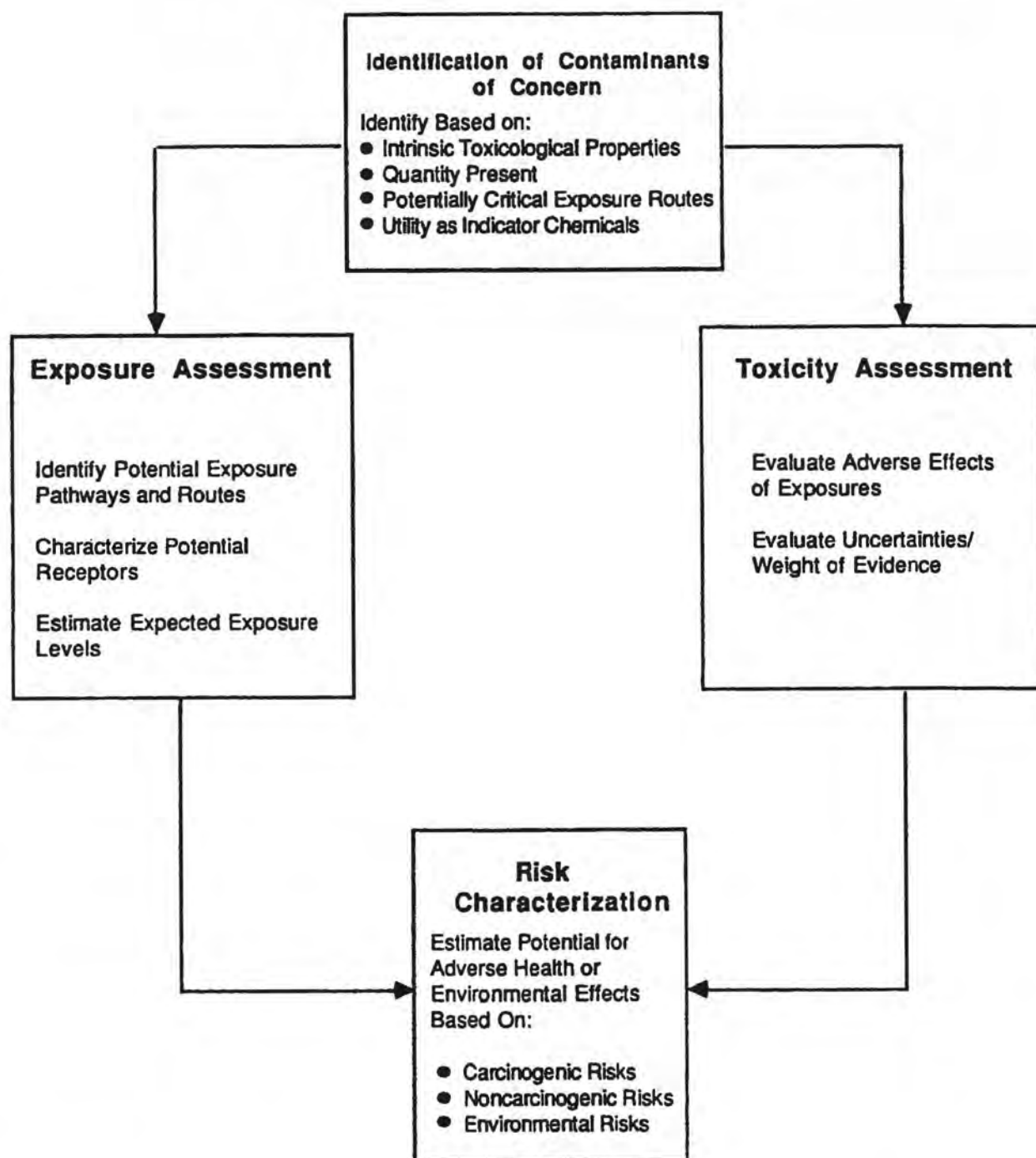


Figure 3-3. Components of the risk assessment process.

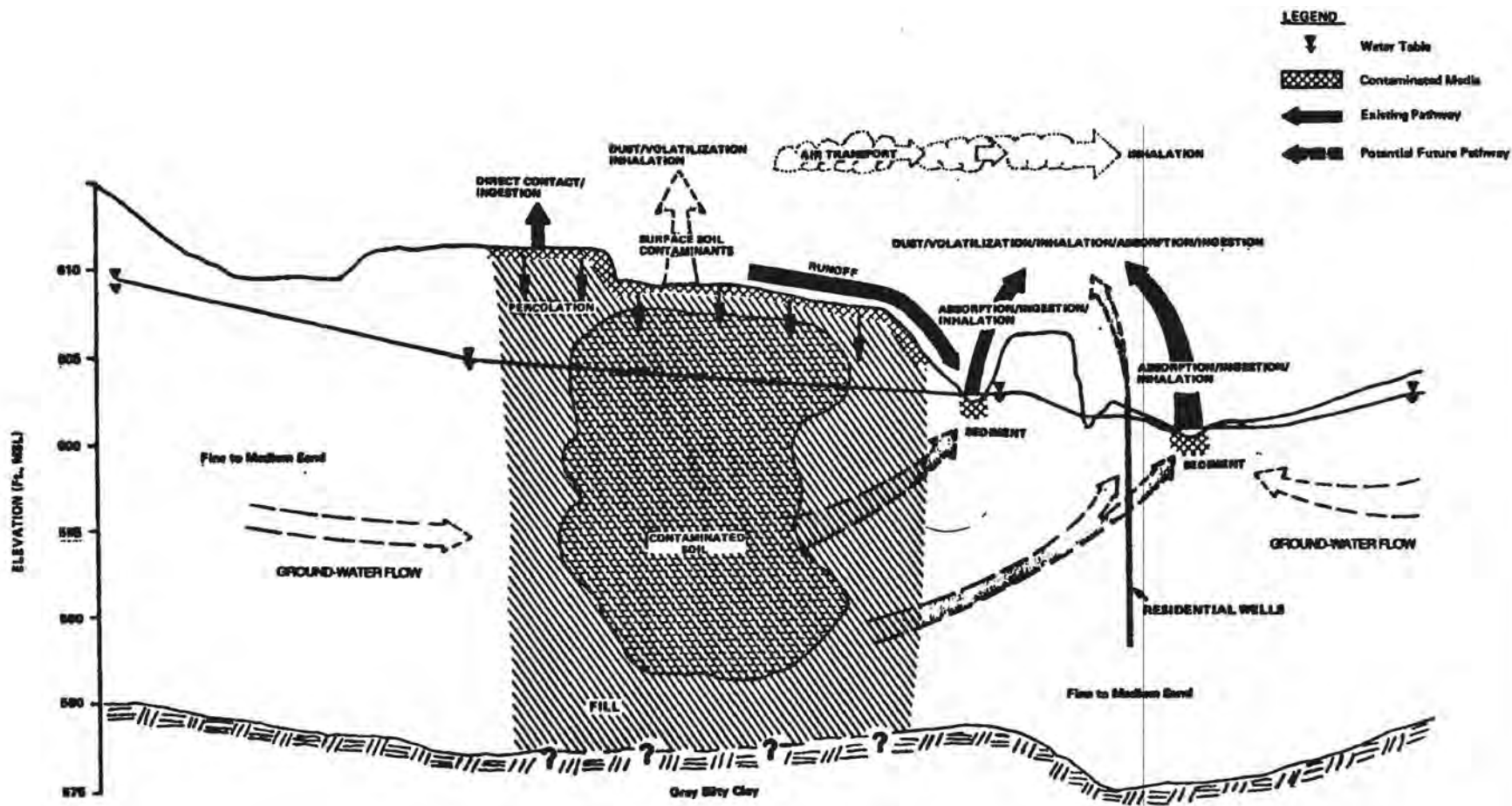


Figure 3-4. Identification of exposure pathways.

procedures is divided into three categories: field activities, sample management and tracking, and document control and inventory.

3.5.1 Field Activities

During site characterization and sampling, consistent documentation and accurate recordkeeping procedures are critical because subsequent decisions will be made on the basis of information gathered during these tasks. Aspects of data management for sampling activities during site characterization include:

- **Quality Assurance/Quality Control (QA/QC) Plans** - These documents provide records of responsibility, adherence to prescribed protocols, nonconformity events, corrective measures, and data deficiencies.
- **A Data Security System** - This system outlines the measures that will be taken in the field to safeguard chain-of-custody records and prevent free access to project records, thereby guarding against accidental or intentional loss, damage, or alteration.
- **Field Logs** - The daily field logs are the primary record for field investigation activities and should include a description of any modifications to the procedures outlined in the work plan, field sampling plan, or health and safety plan, with justifications for such modifications. Field measurements and observations should be recorded directly into the project log books. Examples of field measurements include pH, temperature, conductivity, water flow, air quality parameters, and soil characteristics. Health and safety monitoring, sampling locations, sampling techniques, and a general description of daily activity are typically included in the daily log. Any unusual occurrences or circumstances should be documented in these logs and can be used for reference in determining the possible causes for data anomalies discovered during data analysis. Data must be recorded directly and legibly in field log books with entries signed and dated. Changes made to original notes should not obliterate the original information and should be dated and signed. Standard format information sheets should be used whenever appropriate and should be retained in permanent files.

Documentation involved in maintaining field sample inventories and proper chain-of-custody records may include the following¹:

¹Specific requirements may vary between state- and federal-head sites.

- Sample Identification Matrix
- Sample Tag
- Traffic Report
- High-Hazard Traffic Report
- SAS Packing List
- Chain-of-Custody Form
- Notice of Transmittal
- Receipt for Samples Form
- Central Regional Laboratory (CRL) Sample Data Report
- Shipping Airbill

Additional information for each of these items, along with the instructions for their completion, can be found in Section 6.2 of the Compendium.

3.5.2 Sample Management and Tracking

A record of sample shipments, receipt of analytical results, submittal of preliminary results for QA/QC review, completion of QA/QC review, and evaluation of the QC package should be maintained to ensure that only final and approved analytical data are used in the site analysis. In some instances, the use of preliminary data is warranted to prepare internal review documents, begin data analysis while minimizing lost time for the turnaround of QA/QC comments, and continue narrowing remedial action alternatives. Preliminary data are considered unofficial, however, and preliminary data used in analyses must be updated upon receipt of official QA/QC comments and changes. Sample results should not be incorporated in the site characterization report unless accompanied by QA/QC comments.

The DQOs stated for each task involving sample analysis must specify whether the information is valid with qualifiers or not and must specify which qualifiers can invalidate the use of certain data. For instance, reproducibility of plus or minus 20 percent may be acceptable in a treatability study but may not be acceptable for determining the risk to human health from drinking water. Acceptability of data quality is not established until the reviewed QA/QC package accompanies the analytical data.

The acceptable QA/QC package should be defined in the approved site QAPP for each discrete task. Where use of the CLP is involved, review by the CRL QA Office is typical but may vary from one Region to the next and may vary from one state to the next in the case of state-lead sites. Nevertheless, the

DQOs outlined for the use of the data will dictate the level of review required.

3.5.3 Document Control and Inventory

Sample results should be managed in a standardized form to promote easy reporting of data in the site characterization report. Precautions should be taken in the analysis and storage of the data collected during site characterization to prevent the introduction of errors or the loss or misinterpretation of data.

The document inventory and filing systems can be set up on the basis of serially numbered documents. These systems may be manual or automated. A suggested structure and sample contents of a file for Superfund activities are shown in Table 3-11. The relationship of this filing system to the Administrative Record is discussed in the "Interim Guidance on Administrative Records for Selection of CERCLA Response Actions" (U.S. EPA, Draft, June 1988).

3.6 Community Relations Activities During Site Characterization

Two-way communication with interested members of the community should be maintained throughout the RI. The remedial project manager and Community Relations Coordinator keep local officials and concerned citizens apprised of site activities and of the schedule of events by implementing several community relation activities. These actions are usually delineated in the community relations plan and typically include, but are not limited to, public information meetings at the beginning and end of the RI; a series of fact sheets that will be distributed to the community during the investigation and will describe up-to-date progress and plans for remedial activities; telephone briefings for key members of the community, public officials and representatives of concerned citizens, and periodic news releases that describe progress at the site.

The files containing the Administrative Record should be established once the RI/FS work plan is finalized and kept at or near the site. It is recommended that the files containing the Administrative Record be kept at one of the information repositories for public information at or near the site and near available copying facilities. Copies of site-related information should be made available to the community and should typically include the RI/FS work plan, a summary of monitoring results, fact sheets, and the community relations plan. The objective of community relations activities during the RI is to educate the public on the remedial process and keep the community informed of project developments as they occur, thereby reducing the likelihood of conflict arising from a lack of information, misinformation, or speculation. As directed in the community relations

Table 3-11. Outline of Suggested File Structure for Superfund Sites

Congressional Inquiries and Hearings:
• Correspondence
• Transcripts
• Testimony
• Published hearing records
Remedial Response:
• Discovery
- Initial investigation reports
- Preliminary assessment report
- Site inspection report
- Hazard Ranking System data
Remedial planning
- Correspondence
- Work plans for RI/FS
- RI/FS reports
- Health and safety plan
- QA/QC plan
- Record of decision/responsiveness summary
Remedial implementation
- Remedial design reports
- Permits
- Contractor work plans and progress reports
- Corps of Engineers agreements, reports, and correspondence
State and other agency coordination
- Correspondence
- Cooperative agreement/Superfund state contract
- State quarterly reports
- Status of state assurances
- Interagency agreements
- Memorandum of Understanding with the state
Community relations
- Interviews
- Correspondence
- Community relations plan
- List of people to contact, e.g., local officials, civic leaders, environmental groups
- Meeting summaries
- Press releases
- News clippings
- Fact sheets
- Comments and responses
- Transcripts
- Summary of proposed plan
- Responsiveness summary
Imagery:
• Photographs
• Illustrations
• Other graphics
Enforcement
• Status reports
• Cross-reference to any confidential enforcement files and the person to contact
• Correspondence
• Administrative orders
Contracts
• Site-specific contracts
• Procurement packages
• Contract status notifications
• List of contractors
Financial Transactions:
• Cross-reference to other financial files and the person to contact
• Contractor cost reports
• Audit reports

plan, all activities should be tailored to the community and to the site.

3.7 Reporting and Communication During Site Characterization

During site characterization, communication is required between the lead agency and the support agency.¹² In addition to routine communication between members of the lead agency and their contractor on project progress, written communication is required between the lead agency and the support agency as follows:

1. The lead agency should provide the draft work plan to the support agency for review and comment (discussed in Chapter 2.)
2. The lead agency should provide information on contaminant types and affected media to the support agency for ARAR identification (chemical- and location-specific ARAR determinations are finalized once the site characterization is complete).
3. The lead agency should provide data obtained during site characterization to ATSDR.¹³
4. The lead agency should provide a preliminary summary of site characterization to the support agency (this may serve as the mechanism for ARAR identification).
5. The lead agency should provide a draft RI report for review and comment by the support agency.

Table 3-12 summarizes the points during site characterization when written or oral communication is recommended.

3.7.1 Information for ARAR Identification

The information for the support agency's use in identifying ARARs should include a description of the contaminants of concern, the affected media, and any physical features that may help identify location-specific ARARs. This information may be supplied by the preliminary site characterization summary (as

discussed below) or by a letter or other document. The support agency shall provide location- and chemical-specific ARARs to the lead agency before preparation of the draft RI report.

3.7.2 Preliminary Site Characterization Summary

A summary of site data following the completion of initial field sampling and analysis should be prepared. This summary should briefly review the analytical results of investigative activities to provide the lead agency with a reference for evaluating the development and screening of remedial alternatives. In addition, the preliminary site characterization summary may be used to assist the support agency in identification of ARARs and provide ATSDR with data (prior to issuance of the draft RI) to assist in their health assessment efforts.

The format of this summary is optional and is left to the discretion of the lead-agency RPM. The format may range from a technical memorandum, which simply lists the locations and quantities of contaminants at the site, to a rough draft of the first four chapters of the RI report (see Table 3-13). Use of the technical memorandum and a progress meeting is strongly encouraged over the latter to better facilitate RI/FS schedules and sampling progress in the field.

3.7.3 Draft RI Report

A draft RI report should be produced for review by the support agency and submitted to ATSDR for its use in preparing a health assessment and also serve as documentation of data collection and analysis in support of the FS. The draft RI report can be prepared any time between the completion of the baseline risk assessment and the completion of the draft FS. Therefore, *the draft RI report should not delay the initiation or execution of the FS.*

Table 3-13 gives a suggested format for the draft RI report. The report should focus on the media of concern and, therefore, does not need to address all the site characteristics listed, only those appropriate at that specific site.

¹² Reporting and communicating during a PRP-lead RI/FS is discussed in Appendix A and in the forthcoming "Draft Guidance on Oversight of Potentially Responsible Party Remedial Investigations and Feasibility Studies."

¹³ Guidance for coordinating remedial and ATSDR health assessment activities is provided in OSWER Directive 9285.4-02.

Table 3-12. Reporting and Communication During Site Characterization

Information Needed	Purpose	Potential Methods of Information Provision
Need to rescope field activities on the basis of results of field observations	Needed only if screening indicates that field activities need to be rescoped; for lead agency and contractor to identify methods to improve effectiveness of site characterization activities; for lead agency to obtain support agency review and concurrence	Meeting Tech memo Other
Need to rescope field activities on the basis of results of sample analysis	Needed only if analysis of laboratory data indicates field activities need to be rescoped; for lead agency and contractor to identify methods to improve effectiveness of site characterization activities; for lead agency to obtain support agency review and concurrence	Meeting Tech memo Other
Preliminary results of field investigation tasks (e.g., geophysical explorations, monitoring well installation, etc.)	Provided by the contractor to the lead agency; need and method of communication at lead agency's discretion	Tech memos Other
Descriptive and analytical results of initial site characterization results (excluding risk assessment)	Provides lead agency with early summary of site data; assists in supporting agency with identification of ARARs; may also be submitted to ATSDR for use in preparing health assessment.	Preliminary site characterization summary
Listing of contaminants, affected media; location of wetlands, historic sites, etc.	For support agency's use in identifying chemical- and location-specific ARARs.	Preliminary site characterization summary
Refined remedial action objectives	For lead agency and contractor to define the basis for developing remedial action alternatives; obtain review and comment from the support agency	Meeting Tech memo Other
Documentation of site characterization field activities and analyses including any treatability testing	Required for members of lead agency and their contractor to prepare for public comment and FS support documentation	Draft RI report

Table 3-13. Suggested RI Report Format

Executive Summary

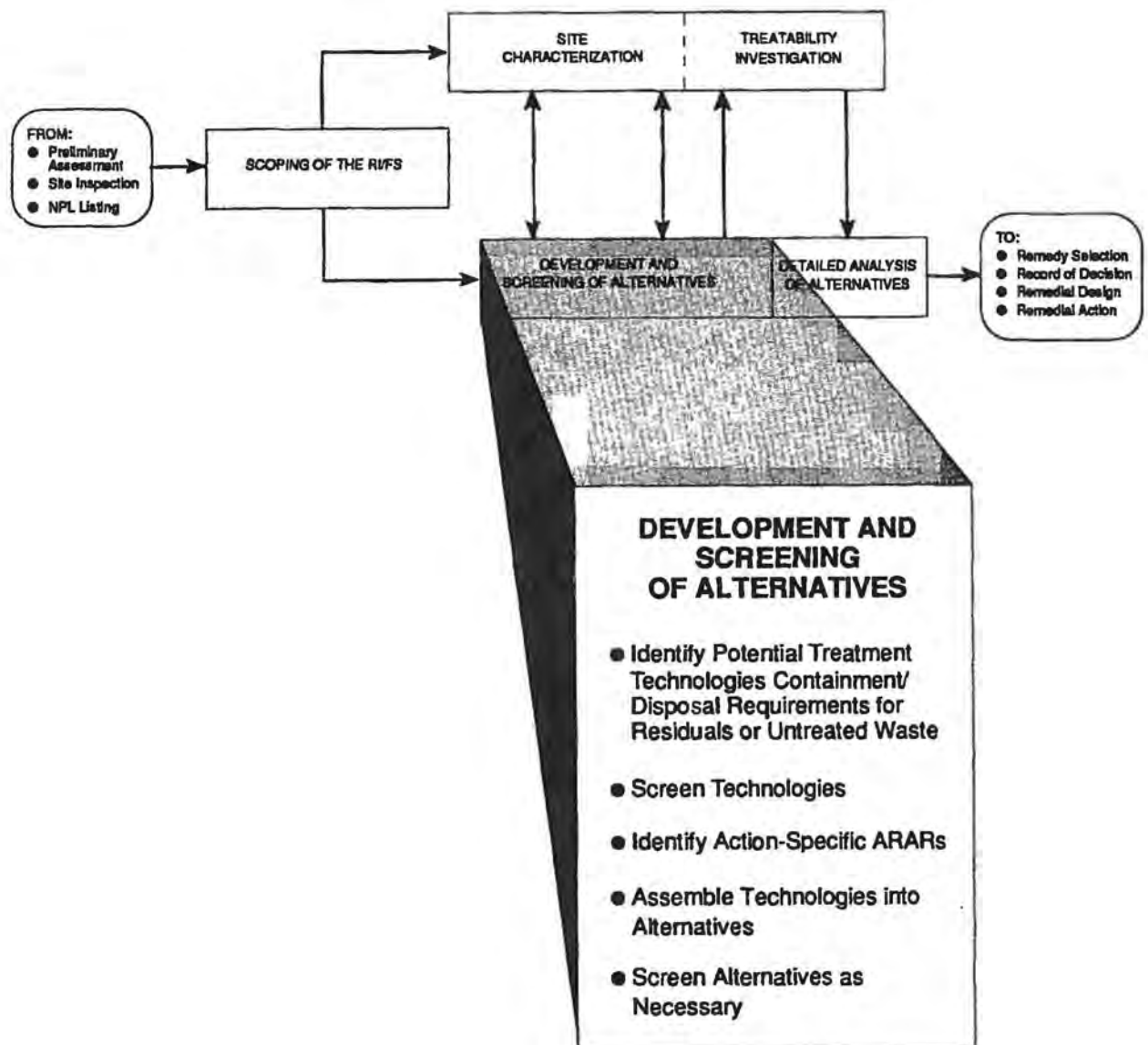
1. Introduction
 - 1.1 Purpose of Report
 - 1.2 Site Background
 - 1.2.1 Site Description
 - 1.2.2 Site History
 - 1.2.3 Previous investigations
 - 1.3 Report Organization
 2. Study Area Investigation
 - 2.1 Includes field activities associated with site characterization. These may include physical and chemical monitoring of some, but not necessarily all, of the following:
 - 2.1.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
 - 2.1.2 Contaminant Source Investigations
 - 2.1.3 Meteorological Investigations
 - 2.1.4 Surface-Water and Sediment Investigations
 - 2.1.5 Geological Investigations
 - 2.1.6 Soil and Vadose Zone Investigations
 - 2.1.7 Ground-Water Investigations
 - 2.1.8 Human Population Surveys
 - 2.1.9 Ecological Investigations
 - 2.2 If technical memoranda documenting field activities were prepared, they may be included in an appendix and summarized in this report chapter.
 3. Physical Characteristics of the Study Area
 - 3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following:
 - 3.1.1 Surface Features
 - 3.1.2 Meteorology
 - 3.1.3 Surface-Water Hydrology
 - 3.1.4 Geology
 - 3.1.5 Soils
 - 3.1.6 Hydrogeology
 - 3.1.7 Demography and Land Use
 - 3.1.8 Ecology
 4. Nature and Extent of Contamination
 - 4.1 Presents the results of site characterization, both natural chemical components and contaminants in some, but not necessarily all, of the following media:
 - 4.1.1 Sources (lagoons, sludges, tanks, etc.)
 - 4.1.2 Soils and Vadose Zone
 - 4.1.3 Ground Water
 - 4.1.4 Surface Water and Sediments
 - 4.1.5 Air
 5. Contaminant Fate and Transport
 - 5.1 Potential Routes of Migration (i.e., air, ground water, etc.)
 - 5.2 Contaminant Persistence
 - 5.2.1 If they are applicable (i.e., for organic contaminants), describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.
 - 5.3 Contaminant Migration
 - 5.3.1 Discuss factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of ground water, etc.)
 - 5.3.2 Discuss modeling methods and results, if applicable.
 6. Baseline Risk Assessment
 - 6.1 Human Health Evaluation
 - 6.1.1 Exposure Assessment
 - 6.1.2 Toxicity Assessment
 - 6.1.3 Risk Characterization
 - 6.2 Environmental Evaluation
-

Table 3-13 Continued

- 7. Summary and Conclusions
 - 7.1 Summary
 - 7.1.1 Nature and Extent of Contamination
 - 7.1.2 Fate and Transport
 - 7.1.3 Risk Assessment
 - 7.2 Conclusions
 - 7.2.1 Data Limitations and Recommendations for Future Work
 - 7.2.2 Recommended Remedial Action Objectives
 - Appendices
 - A. Technical Memoranda on Field Activities (if available)
 - B. Analytical Data and QA/QC Evaluation Results
 - C. Risk-Assessment Methods
-

CHAPTER 4

DEVELOPMENT AND SCREENING OF ALTERNATIVES



Chapter 4

Development and Screening of Alternatives

4.1 Introduction

4.1.1 Purpose of Alternative Development and Screening

The primary objective of this phase of the FS is to develop an appropriate range of waste management options that will be analyzed more fully in the detailed analysis phase of the FS. Appropriate waste management options that ensure the protection of human health and the environment may involve, depending on site-specific circumstances, the complete elimination or destruction of hazardous substances at the site, the reduction of concentrations of hazardous substances to acceptable health-based levels, and prevention of exposure to hazardous substances via engineering or institutional controls, or some combination of the above. Alternatives are typically developed concurrently with the RI site characterization, with the results of one influencing the other in an iterative fashion (i.e., RI site characterization data are used to develop alternatives and screen technologies, whereas the range of alternatives developed guides subsequent site characterization and/or treatability studies). An overview of the entire FS process is presented in the following subsections.

4.1.2 FS Process Overview

The FS may be viewed (for explanatory purposes) as occurring in three phases: the development of alternatives, the screening of the alternatives, and the detailed analysis of alternatives. However, in actual practice the specific point at which the first phase ends and the second begins is not so distinct. Therefore, the development and screening of alternatives are discussed together to better reflect the interrelatedness of these efforts. Furthermore, in those instances in which circumstances limit the number of available options, and therefore the number of alternatives that are developed, it may not be necessary to screen alternatives prior to the detailed analysis.

4.1.2.1 Development and Screening of Alternatives

Alternatives for remediation are developed by assembling combinations of technologies, and the media to which they would be applied, into alternatives that address contamination on a sitewide basis or for an identified operable unit. This process consists of six general steps, which are shown in Figure 4-1 and briefly discussed below:

- Develop remedial action objectives specifying the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed. The preliminary remediation goals are developed on the basis of chemical-specific ARARs, when available, other available information (e.g., RfDs), and site-specific risk-related factors.¹
- Develop general response actions for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.
- Identify volumes or areas of media to which general response actions might be applied, taking into account the requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characterization of the site.
- Identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site.² The general response actions are further

¹These preliminary remediation goals are reevaluated as site characterization data and information from the baseline risk assessment become available.

²It is important to distinguish between this medium-specific technology screening step during development of alternatives and the *alternative screening* that may be conducted subsequently to reduce the number of alternatives prior to the detailed analysis.

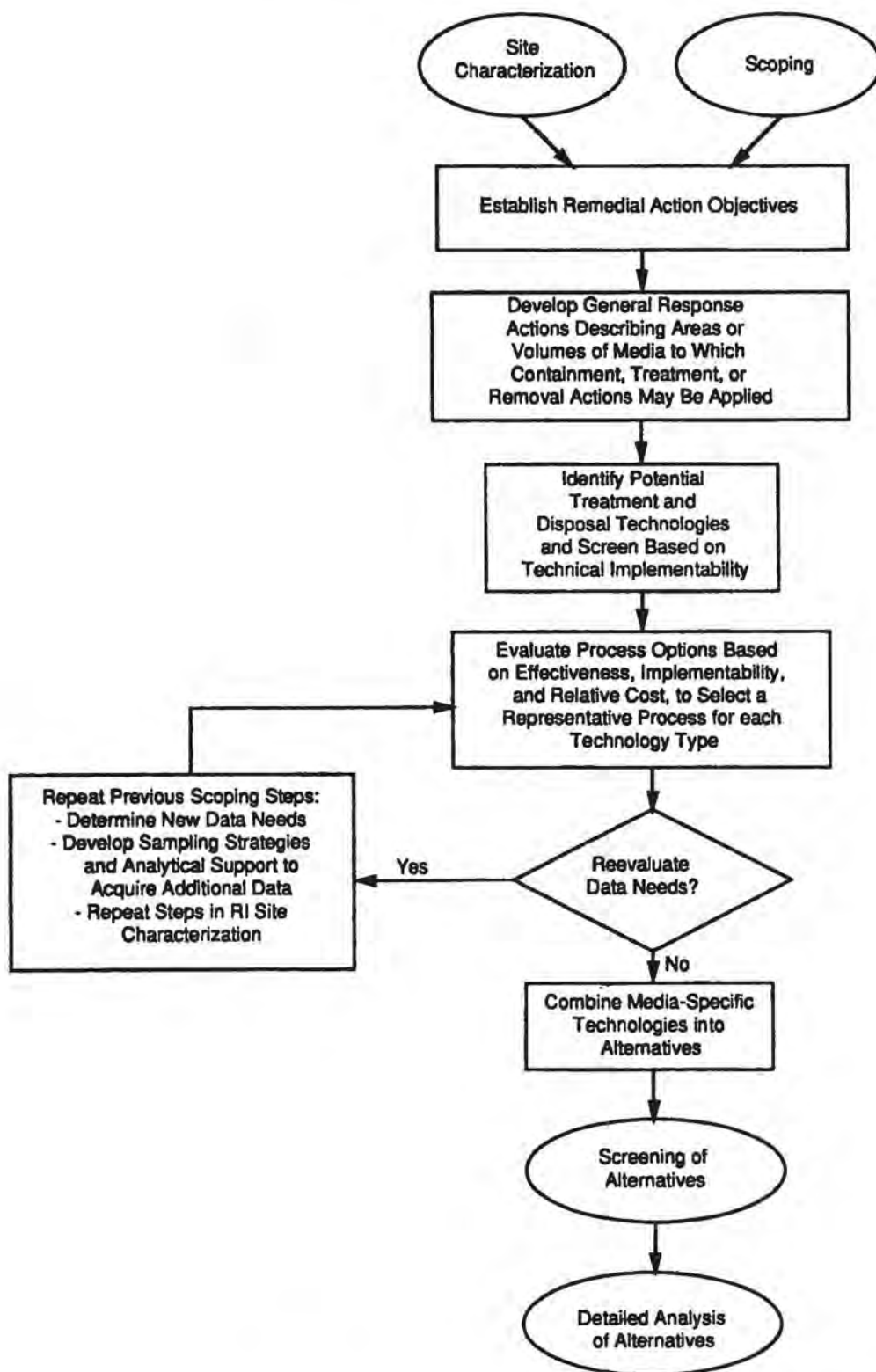


Figure 4-1 Alternative development.

defined to specify remedial technology types (e.g., the general response action of treatment can be further defined to include chemical or biological technology types).

- Identify and evaluate technology process options to select a representative process for each technology type retained for consideration. Although specific processes are selected, for alternative development and evaluation, these processes are intended to represent the broader range of process options within a general technology type.
- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations, as appropriate.

Figure 4-2 provides a generic representation of this process. Section 4.2 contains a more detailed description and specific examples of alternative development.

For those situations in which numerous waste management options are appropriate and developed, the assembled alternatives may need to be refined and screened to reduce the number of alternatives that will be analyzed in detail. This screening aids in streamlining the feasibility study process while ensuring that the most promising alternatives are being considered.

As discussed earlier, in other situations the number of viable or appropriate alternatives for addressing site problems may be limited; thus, the screening effort may be minimized or eliminated if unnecessary. The scope of this screening effort can vary substantially depending on the number and type of alternatives developed and the extent of information necessary for conducting the detailed analysis. The scope and emphasis can also vary depending on either the degree to which the assembled alternatives address the combined threats posed by the entire site or on the individual threats posed by separate site areas or contaminated media. Whatever the scope, the range of treatment and containment alternatives initially developed should be preserved through the alternative screening process to the extent that it makes sense to do so.

As part of the screening process, alternatives are analyzed to investigate interactions among media in terms of both the evaluation of technologies (i.e., the extent to which source control influences the degree of ground-water or air-quality control) and sitewide protectiveness (i.e., whether the alternative provides sufficient reduction of risk from each media and/or pathway of concern for the site or that part of the site being addressed by an operable unit). Also at this stage, the areas and quantities of contaminated

media initially specified in the general response actions may also be reevaluated with respect to the effects of interactions between media. Often, source control actions influence the degree to which ground-water remediation can be accomplished or the time frame in which it can be achieved. In such instances, further analyses may be conducted to modify either the source control or ground-water response actions to achieve greater effectiveness in sitewide alternatives. Using these refined alternative configurations, more detailed information about the technology process options may be developed. This information might include data on the size and capacities of treatment systems, the quantity of materials required for construction, and the configuration and design requirements for ground-water collection systems.

Information available at the time of screening should be used primarily to identify and distinguish any differences among the various alternatives and to evaluate each alternative with respect to its effectiveness, implementability, and cost. Only the alternatives judged as the best or most promising on the basis of these evaluation factors should be retained for further consideration and analysis.³ Typically, those alternatives that are screened out will receive no further consideration unless additional information becomes available that indicates further evaluation is warranted. As discussed in Section 4.2.6, for sites at which interactions among media are not significant, the process of screening alternatives, described here, may be applied to medium-specific options to reduce the number of options that will either be combined into sitewide alternatives at the conclusion of screening or will await further evaluation in the detailed analyses. Section 4.3 contains more detail about screening alternatives.

4.1.2.2 Detailed Analysis of Alternatives

During the detailed analysis, the alternatives brought through screening are further refined, as appropriate, and analyzed in detail with respect to the evaluation criteria described in Chapter 6. Alternatives may be further refined and/or modified based on additional site characterization or treatability studies conducted as part of the RI. The detailed analysis should be conducted so that decision-makers are provided with sufficient information to compare alternatives with respect to the evaluation criteria and to select an appropriate remedy. Analysis activities are described in greater detail in Chapter 6.

³As with the use of representative technologies, alternatives may be selected to represent sufficiently similar management strategies; thus, in effect, a separate analysis for each alternative is not always warranted.

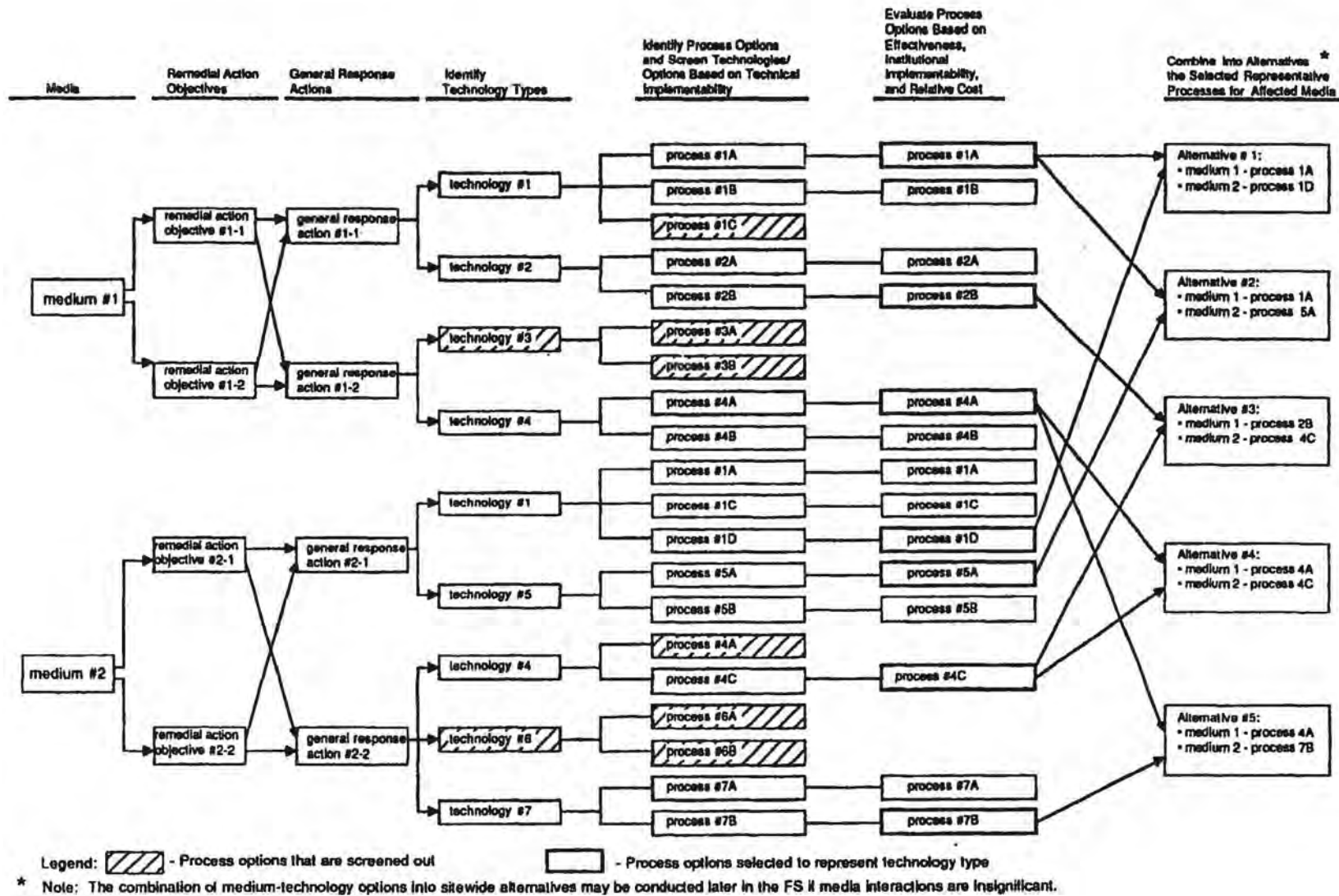


Figure 4-2. Generic alternative development process.

4.1.3 Alternative Ranges

Alternatives should be developed that will provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another. In developing alternatives, the range of options will vary depending on site-specific conditions. A general description of ranges for source control and ground-water response actions that should be developed, as appropriate, are described below.

4.1.3.1 Source Control Actions

For source control actions, the following types of alternatives should be developed to the extent practicable:

- A number of treatment alternatives ranging from one that would eliminate or minimize to the extent feasible the need for long-term management (including monitoring) at a site to one that would use treatment as a primary component of an alternative to address the principal threats at the site.⁴ Alternatives within this range typically will differ in the type and extent of treatment used and the management requirements of treatment residuals or untreated wastes.
- One or more alternatives that involve containment of waste with little or no treatment but protect human health and the environment by preventing potential exposure and/or reducing the mobility of contaminants.
- A no-action alternative⁵

Figure 4-3 conceptually illustrates this range for source control alternatives.

Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low concentrated wastes such as some municipal landfills and mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved. If a full range of alternatives is not

⁴Alternatives for which treatment is a principal element could include containment elements for untreated waste or treatment residuals as well.

⁵Although a no-action alternative may include some type of environmental monitoring, actions taken to reduce the potential for exposure (e.g., site fencing, deed restrictions) should not be included as a component of the no-action alternatives. Such minimal actions should constitute a separate "limited" action alternative.

developed, the specific reasons for doing so should be briefly discussed in the FS report to serve as documentation that treatment alternatives were assessed as required by CERCLA.

4.1.3.2 Ground-water Response Actions

For ground-water response actions, alternatives should address not only cleanup levels but also the time frame within which the alternatives might be achieved. Depending on specific site conditions and the aquifer characteristics, alternatives should be developed that achieve ARARs or other health-based levels determined to be protective within varying time frames using different methodologies. For aquifers currently being used as a drinking water source, alternatives should be configured that would achieve ARARs or risk-based levels as rapidly as possible. More detailed information on developing remedial alternatives for ground-water response actions may be found in "Guidance on Remedial Actions for Contaminated Ground Water at Super-fund Sites" (U.S. EPA, August 1988).

4.2 Alternative Development Process

The alternative development process may be viewed as consisting of a series of analytical steps that involves making successively more specific definitions of potential remedial activities. These steps are described in the following sections.

4.2.1 Develop Remedial Action Objectives

Remedial action objectives consist of medium-specific or operable unit-specific goals for protecting human health and the environment. The objectives should be as specific as possible but not so specific that the range of alternatives that can be developed is unduly limited. Column two of Table 4-1 provides examples of remedial action objectives for various media.

Remedial action objectives aimed at protecting human health and the environment should specify:

- The contaminant(s) of concern
- Exposure route(s) and receptor(s)
- An acceptable contaminant level or range of levels for each exposure route (i.e., a preliminary remediation goal)

Remedial action objectives for protecting human receptors should express both a contaminant level and an exposure route, rather than contaminant levels alone, because protectiveness may be achieved by reducing exposure (such as capping an area, limiting access, or providing an alternate water supply) as well as by reducing contaminant levels. Because

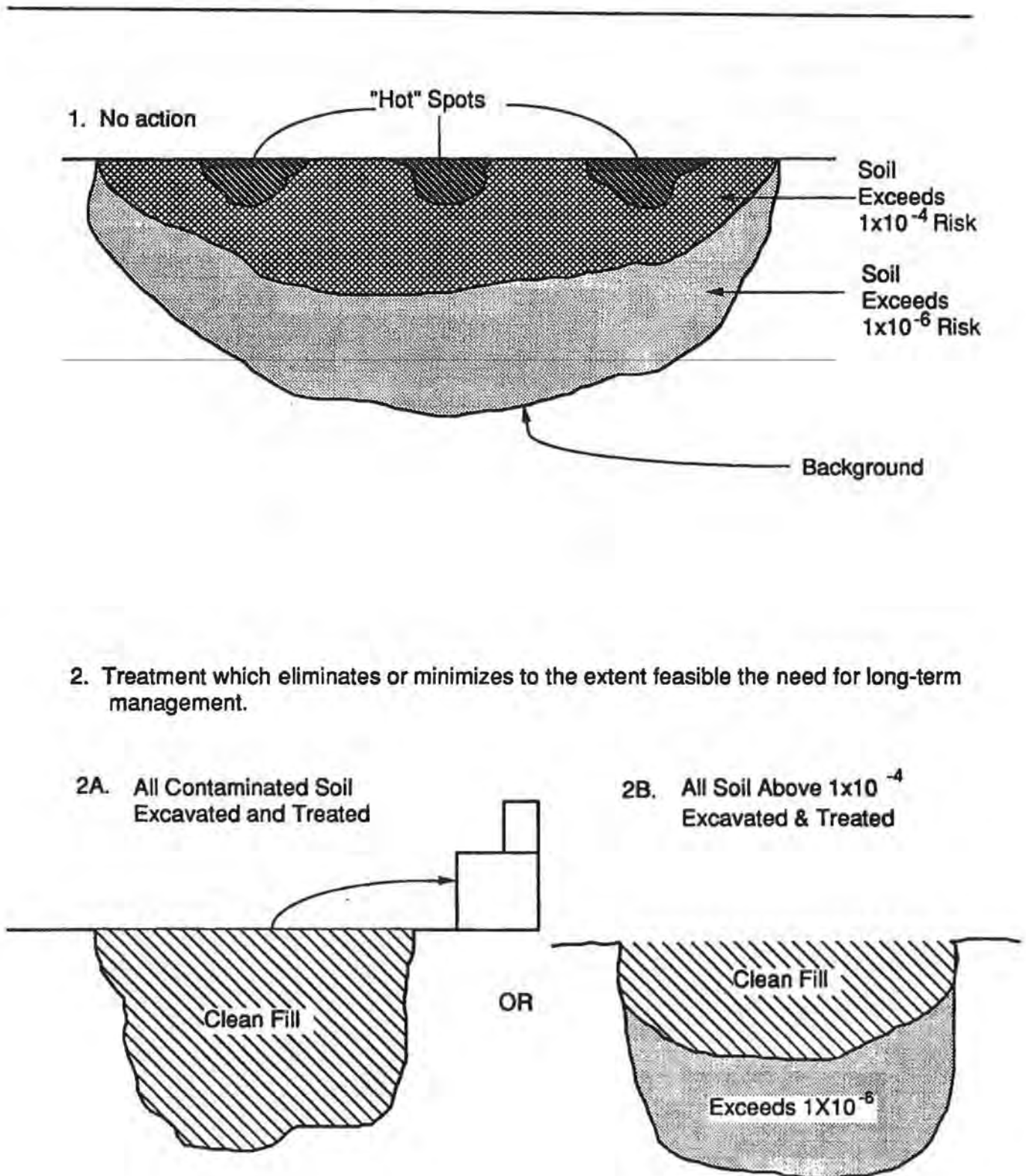
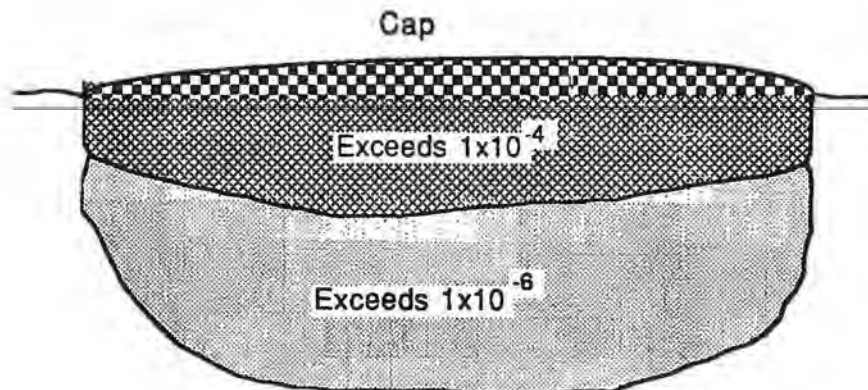


Figure 4-3 Conceptual treatment range for source control.

3. Alternatives using treatment as a principal element

"Hot" Spots Excavated
& Treated



4. Containment with little or no treatment

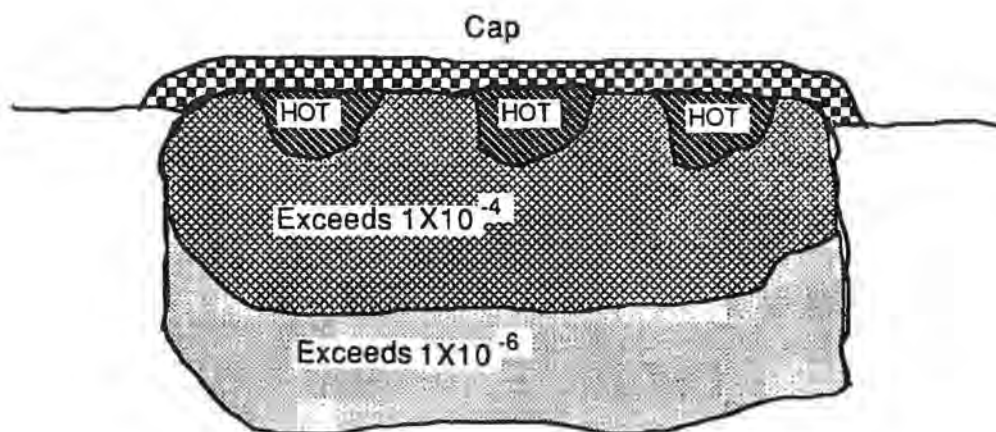


Figure 4-3 (Continued)

Table 4-1. Example of Remedial Action Objectives, General Response Actions, Technology Types, and Example Process Options for the Development and Screening of Technologies

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Actions (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Ground Water	<p><u>For Human Health:</u></p> <p>Prevent ingestion of water having [carcinogen(s)] in excess of [MCL(s)] and a total excess cancer risk (for all contaminants) of greater than 10^{-6} to 10^{-5}.</p> <p>Prevent ingestion of water having [non-carcinogen(s)] in excess of [MCL(s)] or [reference dose(s)].</p> <p><u>For Environmental Protection:</u></p> <p>Restore ground water aquifer to [concentration(s)] for [contaminant(s)].</p>	<p>No Action/Institutional Actions:</p> <p>No action</p> <p>Alternative residential water supply</p> <p>Monitoring</p> <p>Containment Actions:</p> <p>Containment</p> <p>Collection/Treatment Actions:</p> <p>Collection/treatment discharge/ in situ groundwater treatment</p> <p>Individual home treatment units</p>	<p>No Action/Institutional Options:</p> <p>Fencing</p> <p>Deed restrictions</p> <p>Containment Technologies:</p> <p>Capping</p> <p>Vertical barriers</p> <p>Horizontal barriers</p> <p>Extraction Technologies:</p> <p>Ground water collection/pumping</p> <p>Enhanced removal</p> <p>Treatment Technologies:</p> <p>Physical treatment</p> <p>Chemical treatment</p> <p>In situ treatment</p> <p>Disposal Technologies:</p> <p>Discharge to POTW (after treatment)</p> <p>Discharge to surface water (after treatment)</p>	<p>Clay cap, synthetic membrane, multi-layer</p> <p>Slurry wall, sheet piling</p> <p>Liners, grout injection</p> <p>Wells, subsurface or leachate collection</p> <p>Solution mining, vapor extraction, enhanced oil recovery</p> <p>Coagulation/flocculation, oil-water separation, air stripping, adsorption</p> <p>Neutralization, precipitation, ion exchange</p> <p>oxidation/reduction</p> <p>Subsurface bioreclamation</p>
Soil	<p><u>For Human Health:</u></p> <p>Prevent ingestion/direct contact with soil having [non-carcinogen(s)] in excess of [reference dose(s)].</p> <p>Prevent direct contact/ ingestion with soil having 10^{-6} to 10^{-5} excess cancer risk from [carcinogen(s)].</p> <p>Prevent inhalation of [carcinogen(s)] posing excess cancer risk levels of 10^{-6} to 10^{-5}.</p> <p><u>For Environmental Protection:</u></p> <p>Prevent migration of contaminants that would result in ground water contamination in excess of [concentration(s)] for [contaminant(s)].</p>	<p>No Action/Institutional Actions:</p> <p>No action</p> <p>Access restrictions</p> <p>Containment Actions:</p> <p>Containment</p> <p>Excavation/Treatment Actions:</p> <p>Excavation/treatment/disposal</p> <p>In situ treatment</p> <p>Disposal excavation</p>	<p>No Action/Institutional Options:</p> <p>Fencing</p> <p>Deed restrictions</p> <p>Containment Technologies:</p> <p>Capping</p> <p>Vertical barriers</p> <p>Horizontal barriers</p> <p>Surface controls</p> <p>Sediment control barriers</p> <p>Dust controls</p> <p>Removal Technologies:</p> <p>Excavation</p> <p>Treatment Technologies:</p> <p>Solidification, fixation, stabilization, immobilization</p> <p>Dewatering</p> <p>Physical treatment</p> <p>Chemical treatment</p> <p>Biological treatment</p> <p>In situ treatment</p> <p>Thermal treatment</p>	<p>Clay cap, synthetic membrane, multi-layer</p> <p>Slurry wall, sheet piling</p> <p>Liners, grout injection</p> <p>Diversification/collection, grading, soil stabilization</p> <p>Coffer dams, curtain barriers</p> <p>Revegetation, capping</p> <p>Solids excavation</p> <p>Sorption, pozzolanic agents, encapsulation</p> <p>Belt filter press, dewatering, and drying beds</p> <p>Water/solvent leaching (with subsequent liquids treatment)</p> <p>Lime neutralization</p> <p>Cultured micro-organisms</p> <p>Surface bioreclamation</p> <p>Incineration, pyrolysis</p>

Table 4-1. Continued

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Actions (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Surface Water	<p><u>For Human Health:</u></p> <p>Prevent ingestion of water having [carcinogen(s)] in excess of [MCLs] and a total excess cancer risk of greater than 10^{-6} to 10^{-5}.</p> <p>Prevent ingestion of water having [non-carcinogen(s)] in excess of [MCLs] or [reference dose(s)].</p> <p><u>For Environmental Protection:</u></p> <p>Restore surface water to [ambient water quality criteria] for [contaminant(s)].</p>	<p>No Action/Institutional Actions:</p> <p>No action Access restrictions Monitoring</p> <p>Collection/Treatment Actions:</p> <p>Surface water runoff interception/treatment/discharge</p>	<p>No Action/Institutional Options:</p> <p>Fencing Deed restrictions</p> <p>Collection Technologies:</p> <p>Surface controls</p> <p>Treatment Technologies:</p> <p>Physical treatment</p> <p>Chemical treatment</p> <p>Biological treatment (organics)</p> <p>In situ treatment</p> <p>Disposal Technologies:</p> <p>Discharge to POTW (after treatment)</p>	<p>Grading, diversion, and collection</p> <p>Coagulation/flocculation, oil-water separation, filtration, adsorption</p> <p>Precipitation, ion exchange, neutralization, freeze crystallization biological treatment, aerobic and anaerobic spray irrigation</p> <p>In situ precipitation, in situ bioreclamation</p>
Sediment	<p><u>For Human Health:</u></p> <p>Prevent direct contact with sediment having [carcinogen(s)] in excess of 10^{-6} to 10^{-5} excess cancer risk.</p> <p><u>For Environmental Protection:</u></p> <p>Prevent releases of [contaminant(s)] from sediments that would result in surface water levels in excess of [ambient water quality criteria].</p>	<p>No Action/Institutional Actions:</p> <p>No action Access restrictions to Monitoring</p> <p>Excavation Actions:</p> <p>Excavation</p> <p>Excavation/Treatment Actions:</p> <p>Removal/disposal Removal/treatment/disposal</p>	<p>No Action/Institutional Options:</p> <p>Fencing Deed restrictions</p> <p>Removal Technologies:</p> <p>Excavation</p> <p>Containment Technologies:</p> <p>Capping Vertical barriers Horizontal barriers Sediment control barriers</p> <p>Treatment Technologies:</p> <p>Solidification, fixation, stabilization Dewatering Physical treatment</p> <p>Chemical treatment</p> <p>Biological treatment</p> <p>In situ treatment</p> <p>Thermal treatment</p>	<p>Sediments excavation</p> <p>Removal with clay cap, multi-layer, asphalt Slurry wall, sheet piling Liners, grout injection Coffer dams, curtain barriers, capping barriers</p> <p>Sorption, pozzolanic agents, encapsulation</p> <p>Sedimentation, dewatering and drying beds Water/solids leaching (with subsequent treatment) Neutralization, oxidation, electrochemical reduction Landfarming Surface bioreclamation Incineration, pyrolysis</p>
Air	<p><u>For Human Health:</u></p> <p>Prevent inhalation of [carcinogen(s)] in excess of 10^{-6} to 10^{-5} excess cancer risk.</p>	<p>No Action/Institutional Actions:</p> <p>No action Access restrictions to Monitoring</p> <p>Collection Actions:</p> <p>Gas collection</p>	<p>No Action/Institutional Options:</p> <p>Fencing Deed restrictions</p> <p>Removal Technologies:</p> <p>Landfill gas collection</p>	<p>Passive vents, active gas collection systems</p>

Table 4-1. Continued

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Actions (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Structures	<p>For Human Health:</p> <p>Prevent direct contact with [carcinogen(s)] in excess of 10^{-6} to 10^{-5} excess cancer risk.</p> <p>Prevent migration of [carcinogen(s)] which would result in ground water concentrations in excess of [MCLs] or 10^{-6} to 10^{-5} total excess cancer risk level.</p> <p>Prevent migration of [carcinogen(s)] which would result in soil concentrations in excess of [reference dose(s)].</p> <p>For Environmental Protection:</p> <p>Prevent migration of [contaminants] that would result in ground water concentrations in excess of [concentration(s)].</p>	<p>No Action/Institutional Actions:</p> <p>No action Access restrictions</p> <p>Demolition/Treatment Actions:</p> <p>Demolition/disposal Decontamination</p>	<p>No Action/Institutional Options:</p> <p>Fencing Deed restrictions</p> <p>Removal Technologies:</p> <p>Demolition Excavation</p> <p>Treatment Technologies:</p> <p>Solids processing</p> <p>Solids treatment</p>	<p>Demolition Excavation, debris removal</p> <p>Magnetic processes, crushing and grinding, screening Water leaching, solvent leaching, steam cleaning</p>
Solid Wastes	<p>For Human Health:</p> <p>Prevent ingestion/direct contact with wastes having [non-carcinogen(s)] in excess of [reference dose(s)].</p> <p>Prevent ingestion/direct contact with wastes having 10^{-6} to 10^{-5} excess cancer risk from [carcinogen(s)].</p> <p>Prevent inhalation of [carcinogen(s)] posing excess cancer risk levels of 10^{-6} to 10^{-5}.</p> <p>Prevent migration of [carcinogen(s)] which would result in ground water concentrations in excess of [MCLs] or 10^{-6} to 10^{-5} total excess cancer risk levels.</p>	<p>No Action/Institutional Actions:</p> <p>No action Access restrictions to [location]</p> <p>Containment Actions:</p> <p>Containment</p> <p>Excavation/Treatment Actions:</p> <p>Removal/disposal</p> <p>Removal/treatment/disposal</p>	<p>No Action/Institutional Options:</p> <p>Fencing Deed restrictions</p> <p>Containment Technologies:</p> <p>Capping Vertical barriers Horizontal barriers</p> <p>Removal Technologies:</p> <p>Excavation Drum removal</p> <p>Treatment Technologies:</p> <p>Physical treatment</p> <p>Chemical treatment Biological treatment Thermal treatment</p> <p>Solids processing</p>	<p>Clay cap, synthetic membranes, multi-layer Slurry wall, sheet piling Liners, grout injection Dust controls</p> <p>Solids excavation Drum and debris removal</p> <p>Water/solvent leaching (with subsequent liquids treatment) Neutralization Cultured micro-organisms Incineration, pyrolysis, gaseous incineration Crushing and grinding, screening, classification</p>

Table 4-1. Continued

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Actions (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Solid Wastes (continued)	<p><u>For Environmental Protection:</u></p> <p>Prevent migration of contaminants that would result in ground water contamination in excess of [concentration(s)] for [contaminant(s)].</p>			
Liquid Wastes	<p><u>For Human Health:</u></p> <p>Prevent ingestion/direct contact with wastes having [non-carcinogen(s)] in excess of [reference dose(s)].</p> <p>Prevent ingestion/direct contact with wastes having 10^{-6} to 10^{-5} excess cancer risk from [carcinogen(s)].</p> <p>Prevent inhalation of [carcinogen(s)] posing excess cancer risk levels of 10^{-6} to 10^{-5}.</p> <p>Prevent migration of [carcinogen(s)] which would result in groundwater concentrations in excess of [MCLs] or 10^{-6} to 10^{-5} total excess cancer risk levels.</p> <p><u>For Environmental Protection:</u></p> <p>Prevent migration of contaminants that would result in groundwater contamination in excess of [concentration(s)] for [contaminant(s)].</p>	<p><u>No Action/Institutional Actions:</u></p> <p>No action</p> <p>Access restrictions to [location]</p> <p><u>Containment Actions:</u></p> <p>Containment</p> <p><u>Removal/Treatment Actions:</u></p> <p>Removal/disposal</p> <p>Removal/treatment/disposal</p>	<p><u>No Action/Institutional Options:</u></p> <p>Fencing</p> <p>Deed restrictions</p> <p><u>Containment Technologies:</u></p> <p>Vertical barriers</p> <p>Horizontal barriers</p> <p><u>Removal Technologies:</u></p> <p>Bulk liquid removal</p> <p>Drum removal</p> <p><u>Treatment Technologies:</u></p> <p>Physical treatment</p> <p>Chemical treatment</p> <p>Biological treatment</p> <p>Thermal treatment (organics)</p> <p><u>Disposal Technologies:</u></p> <p>Product reuse</p> <p>Discharge to POTW (after treatment)</p>	<p>Slurry wall</p> <p>Liners</p> <p>Bulk liquid removal</p> <p>Drum removal</p> <p>Coagulation/flocculation, adsorption, evaporation, distillation</p> <p>Neutralization, oxidation, reduction, photolysis</p> <p>Aerobic/anaerobic biological treatment, biotechnologies</p> <p>Incineration, pyrolysis, co-disposal</p>
Sludges	<p><u>For Human Health:</u></p> <p>Prevent direct contact with sludge having [carcinogen(s)] in excess of 10^{-6} to 10^{-5} excess cancer risk.</p> <p>Prevent ingestion/contact with sludge having [non-carcinogen(s)] in excess of [reference dose(s)].</p>	<p><u>No Action/Institutional Actions:</u></p> <p>No action</p> <p>Access restrictions to [location]</p> <p><u>Containment Actions:</u></p> <p>Containment</p> <p><u>Removal/Treatment Actions:</u></p> <p>Removal/disposal</p>	<p><u>No Action/Institutional Options:</u></p> <p>Fencing</p> <p>Deed restrictions</p> <p><u>Containment Technologies:</u></p> <p>Vertical barriers</p> <p>Horizontal barriers</p> <p><u>Removal Technologies:</u></p> <p>Bulk sludge removal</p> <p>Drum removal</p> <p><u>Treatment Technologies:</u></p> <p>Solidification, fixation</p>	<p>Slurry wall, sheet piling</p> <p>Liners</p> <p>Semi-solid excavation, pumping</p> <p>Drum removal</p> <p>Sorption, pozzolanic agents, encapsulation</p>

Table 4-1. Continued

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Actions (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Sludges (continued)	<p>Prevent migration of [carcinogen(s)] which would result in ground water concentrations in excess of 10^{-4} to 10^{-5} excess cancer risk.</p> <p><u>For Environmental Protection:</u></p> <p>Prevent releases of [contaminant(s)] from sludge that would result in surface water levels in excess of [ambient water quality criteria].</p> <p>Prevent releases of [contaminant(s)] from sludge that would result in ground water levels of [contaminant(s)] in excess of [concentration(s)].</p>	Removal/treatment/disposal	<p>Physical treatment</p> <p>Chemical treatment</p> <p>Biological treatment</p> <p>Thermal treatment (organics)</p> <p>Dewatering</p> <p>Disposal Technologies:</p> <p>Product reuse</p> <p>Landfilling (after treatment)</p>	<p>Freeze crystallization, neutralization, oxidation, electrochemical reduction</p> <p>Oxidation, reduction, photolysis</p> <p>Aerobic/anaerobic treatment, land treatment new biotechnologies</p> <p>Incineration, pyrolysis, co-disposal</p> <p>Gravity thickening, belt filter press, vacuum filtration</p>

remedial action objectives for protecting environmental receptors typically seek to preserve or restore a resource (e.g., as ground water), environmental objective(s) should be expressed in terms of the medium of interest and target cleanup levels, whenever possible.

Although the preliminary remediation goals are established on readily available information [e.g., reference doses (RfDs) and risk-specific doses (RSDs)] or frequently used standards (e.g., ARARs), the final acceptable exposure levels should be determined on the basis of the results of the baseline risk assessment and the evaluation of the expected exposures and associated risks for each alternative. Contaminant levels in each media should be compared with these acceptable levels and include an evaluation of the following factors:

- Whether the remediation goals for all carcinogens of concern, including those with goals set at the chemical-specific ARAR level, provides protection within the risk range of 10^{-4} to 10^{-7} .
- Whether the remediation goals set for all non-carcinogens of concern, including those with goals set at the chemical-specific ARAR level, are sufficiently protective at the site.
- Whether environmental effects (in addition to human health effects) are adequately addressed.
- Whether the exposure analysis conducted as part of the risk assessment adequately addresses each significant pathway of human exposure identified in the baseline risk assessment. For example, if the exposure from the ingestion of fish and drinking water are both significant pathways of exposure, goals set by considering only one of these exposure pathways may not be adequately protective. The SPHEM provides additional details on establishing acceptable exposure levels.

4.2.2 Develop General Response Actions

General response actions describe those actions that will satisfy the remedial action objectives. General response actions may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these. Like remedial action objectives, general response actions are medium-specific.

General response actions that might be used at a site are initially defined during scoping and are refined throughout the RI/FS as a better understanding of site conditions is gained and action-specific ARARs are identified. In developing alternatives, combinations of general response actions may be identified, particularly when disposal methods primarily depend on whether the medium has been previously treated.

Examples of potential general response actions are included in column three of Table 4-1.

4.2.3 Identify Volumes or Areas of Media

During the development of alternatives an initial determination is made of areas or volumes of media to which general response actions might be applied. This initial determination is made for each medium of interest at a site. To take interactions between media into account, response actions for areas or volumes of media are often refined after sitewide alternatives have been assembled. The refinement of alternatives is discussed at greater length in Section 4.3.1.

Defining the areas or volumes of media requires careful judgment and should include a consideration of not only acceptable exposure levels and potential exposure routes, but also site conditions and the nature and extent of contamination. For example, in an area with contamination that is homogeneously distributed in a medium, discrete risk levels (e.g., 10^{-4} , 10^{-6}) or corresponding contaminant levels may provide the most rational basis for defining areas or volumes of media to which treatment, containment, or excavation actions may be applied. For sites with discrete hot spots or areas of more concentrated contamination, however, it may be more useful to define areas and volumes for remediation on the basis of the site-specific relationship of volume (or area) to contaminant level. Therefore, when areas or volumes of media are defined on the basis of site-specific considerations such as volume versus concentration relationships, the volume or area addressed by the alternative should be reviewed with respect to the remedial action objectives to ensure that alternatives can be assembled to reduce exposure to protective levels.

4.2.4 Identify and Screen Remedial Technologies and Process Options

In this step, the universe of potentially applicable technology types and process options is reduced by evaluating the options with respect to technical implementability. In this guidance document, the term "technology types" refers to general categories of technologies, such as chemical treatment, thermal destruction, immobilization, capping, or dewatering. The term "technology process options" refers to specific processes within each technology type. For example, the chemical treatment technology type would include such process options as precipitation, ion exchange, and oxidation/reduction. As shown in columns four and five of Table 4-1, several broad technology types may be identified for each general response action, and numerous technology process options may exist within each technology type.

Technology types and process options may be identified by drawing on a variety of sources including

references developed for application to Superfund sites and more standard engineering texts not specifically directed toward hazardous waste sites. Some of these sources are included in Appendix D of this document.

During this screening step, process options and entire technology types are eliminated from further consideration on the basis of technical implementability. This is accomplished by using readily available information from the RI site characterization on contaminant types and concentrations and onsite characteristics to screen out technologies and process options that cannot be effectively implemented at the site.

Two factors that commonly influence technology screening are the presence of inorganic contaminants, which limit the applicability of many types of treatment processes, and the subsurface conditions, such as depth to impervious formations or the degree of fracture in bedrock, which can limit many types of containment and ground-water collection technologies. This screening step is site-specific, however, and other factors may need to be considered. Figure 4-4 provides an example of initial technology screening for ground-water remediation at a site having organic and inorganic contaminants and shallow, fractured bedrock.

As with all decisions during an RI/FS, the screening of technologies should be documented. For most studies, a figure similar to Figure 4-4 provides adequate information for this purpose and can be included in the FS report.

4.2.5 Evaluate Process Options

In the fourth step of alternative development, the technology processes considered to be implementable are evaluated in greater detail before selecting one process to represent each technology type. One representative process is selected, if possible, for each technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase. In some cases more than one process option may be selected for a technology type. This may be done if two or more processes are sufficiently different in their performance that one would not adequately represent the other.

Process options are evaluated using the same criteria - effectiveness, implementability, and cost - that are used to screen alternatives prior to the detailed analysis. An important distinction to make is that at

this time these criteria are applied only to technologies and the general response actions they are intended to satisfy and not to the site as a whole. Furthermore, the evaluation should typically focus on effectiveness factors at this stage with less effort directed at the implementability and cost evaluation.

Because of the limited data on innovative technologies, it may not be possible to evaluate these process options on the same basis as other demonstrated technologies. Typically, if innovative technologies are judged to be implementable they are retained for evaluation either as a "selected" process option (if available information indicates that they will provide better treatment, fewer or less adverse effects, or lower costs than other options), or they will be "represented" by another process option of the same technology type. The evaluation of process options is illustrated in Figure 4-5 and discussed in more detail below.


4.2.5.1 Effectiveness Evaluation

Specific technology processes that have been identified should be evaluated further on their effectiveness relative to other processes within the same technology type. This evaluation should focus on: (1) the potential effectiveness of process options in handling the estimated areas or volumes of media and meeting the remediation goals identified in the remedial action objectives;² (2) the potential impacts to human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site.

Information needed to evaluate the effectiveness of technology types for the different media includes contaminant type and concentration, the area or volume of contaminated media, and, when appropriate, rates of collection of liquid or gaseous media. For some media it may be necessary to conduct preliminary analyses or collect additional site data to adequately evaluate effectiveness. This is often the case for processes in which the rates of removal or collection and treatment are needed for evaluation, such as for ground-water extraction, surface-water collection and treatment, or subsurface gas collection. In such cases, a limited conceptual design of the process may need to be developed, and modeling of the potential environmental transport mechanisms associated with their operation may be undertaken. Typically, however, such analyses are conducted during the

²The ability of some collection/removal systems, such as ground-water pumping, to sufficiently recover contaminated media for subsequent treatment may also be assessed as part of this evaluation.

Ground Water General Response Actions	Remedial Technology	Process Options	Description	Screening Comments*
No Action	None	Not applicable	No action	Required for consideration by NCP
Institutional Actions	Access restrictions	Deed restrictions	Deeds for property in the area of influence would include restrictions on wells	Potentially applicable
	Alternate water supply	City water supply	Extension of existing municipal well system to serve residents in the area of influence	Potentially applicable
		New community well	New uncontaminated wells to serve residents in the area of influence	Potentially applicable
	Monitoring	Ground-water monitoring	Ongoing monitoring of wells	Potentially applicable
Collection/ Discharge	Extraction	Extraction wells	Series of wells to extract contaminated ground water	Not feasible for intercepting contaminants in fractured bedrock
		Extraction/injection wells	Injection wells inject uncontaminated water to increase flow to extraction wells	Not feasible for intercepting contaminants in fractured bedrock
	Subsurface drains	Interceptor trenches	Perforated pipe in trenches backfilled with porous media to collect contaminated water	Potentially applicable
	Onsite discharge	Local stream	Extracted water discharged to stream on the site	Potentially applicable
	Offsite discharge	Deep well injection	Extracted water discharged to deep well injection system	Deep aquifer not suitable for injection of contaminants
		POTW	Extracted water discharged to local POTW for treatment	Potentially applicable
		Pipeline to river	Extracted water discharged to river offsite	Potentially applicable
	Containment	Cap	Clay and soil	Compacted clay covered with soil over areas of contamination
Asphalt			Spray application of a layer of asphalt over areas of contamination	Potentially applicable
Concrete			Installation of a concrete slab over areas of contamination	Potentially applicable
Multimedia cap			Clay and synthetic membrane covered by soil over areas of contamination	Potentially applicable
Vertical barriers		Slurry wall	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry	Not feasible because of very shallow depth to bedrock
		Grout curtain	Pressure injection of grout in a regular pattern of drilled holes	Not effective because of fractured bedrock
		Vibrating beam	Vibrating force to advance beams into the ground with injection of slurry as beam is withdrawn	Not feasible because of very shallow depth to bedrock
Horizontal barriers		Grout injection	Pressure injection of grout at depth through closely spaced drilled holes	Not effective because of fractured bedrock
		Block displacement	In conjunction with vertical barriers, injection of slurry in notched injection holes	Not feasible because of very shallow depth to bedrock

Legend  - Technologies that are screened out.

* Screening comments may or may not be applicable to actual sites.

Figure 4-4. An example of Initial screening of technologies and process options.

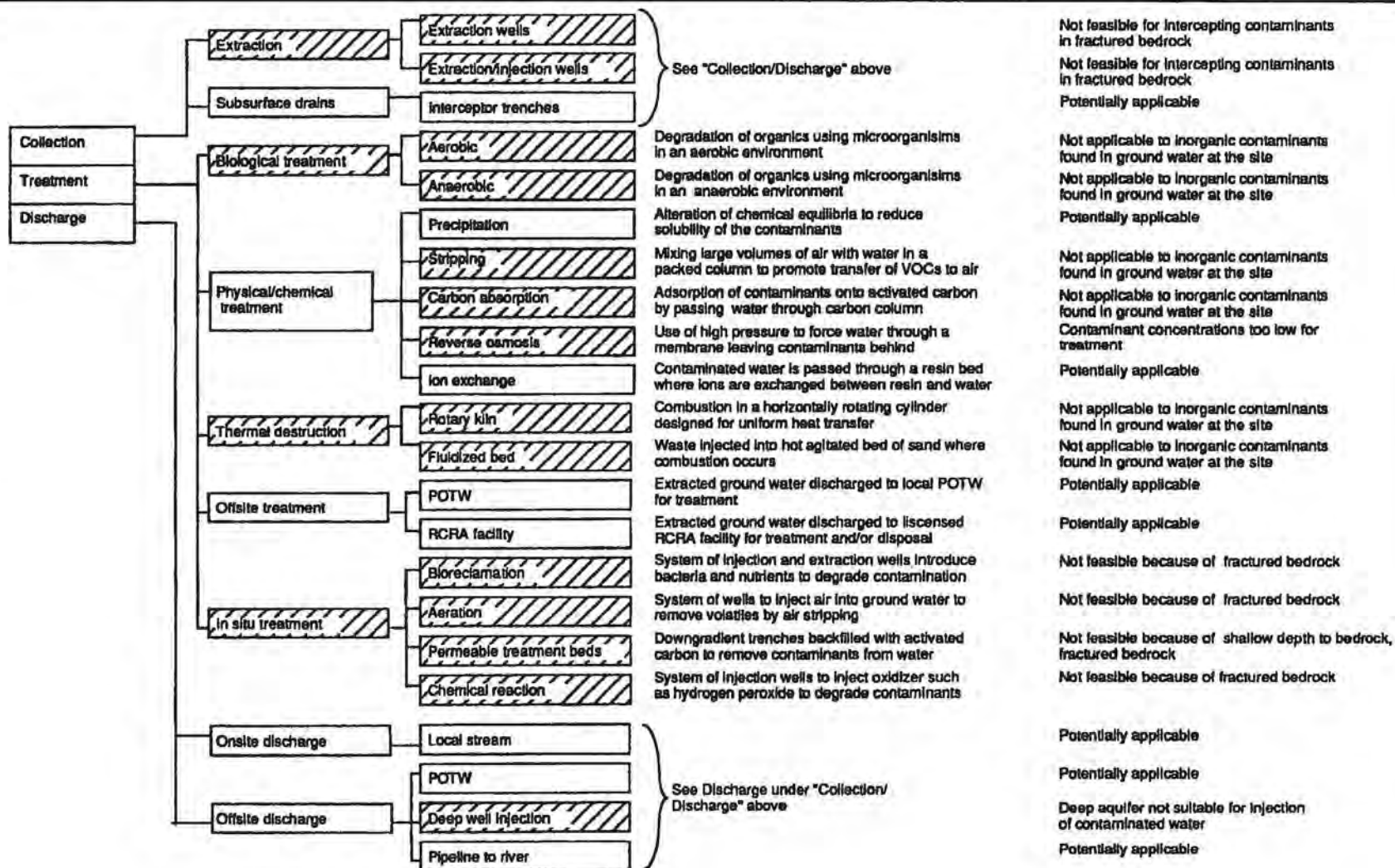
Ground Water General Response Actions

Remedial Technology

Process Options

Description

Screening Comments*



Legend - Technologies that are screened out.

*Screening comments may or may not be applicable to actual sites.

Figure 4-4. Continued.

Ground Water General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
No Action	None	Not applicable	Does not achieve remedial action objectives	Not acceptable to local/public government.	None.
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination.	Legal requirements and authority.	Negligible cost.
	Alternate water supply	City water supply	Effective in preventing use of contaminated ground water. No contaminant reduction.	Conventional construction, requires local approvals.	High capital, low O&M.
		New community well	Effective in preventing use of contaminated ground water. No contaminant reduction.	Conventional construction, requires local approvals.	High capital, low O&M.
	Monitoring	Ground water monitoring	Useful for documenting conditions. Does not reduce risk by itself.	Alone, not acceptable to public/local government.	Low capital, low O&M.
Collection/ Discharge	Subsurface drains	Interceptor trenches	Effective for downgradient fracture flow interception.	Very difficult to implement—requires deep trenching through rock.	Very high capital, low O&M.
	Onsite discharge	Local stream	Effective and reliable discharge method. Does not eliminate contamination.	Discharge permits required.	Low capital, very low O&M.
	Offsite discharge	POTW	Effective and reliable discharge method. Does not eliminate contamination.	Discharge permits required.	High capital, low O&M.
		Pipeline to river	Effective and reliable discharge method. Does not eliminate contamination.	Discharge permits required.	High capital, low O&M.
Containment	Cap	Clay + soil	Effective, susceptible to cracking, but has self-healing properties.	Easily implemented. Restrictions on future land use.	Low capital, low maintenance.
		Asphalt	Effective but susceptible to weathering and cracking.	Easily implemented. Restrictions on future land use.	Low capital, high maintenance.
		Concrete	Effective but susceptible to weathering and cracking.	Easily implemented. Restrictions on future land use.	Moderate capital, high maintenance.
		Multi-media cap	Effective, least susceptible to cracking.	Easily implemented. Restrictions on future land use.	Moderate capital, mod. maintenance.
Collection/ Treatment/ Discharge	Subsurface drains	Interceptor trenches	Effective for downgradient fracture flow interception.	Very difficult to implement—requires deep trenching through rock	Very high capital, low O&M.
	Physical/chemical treatment	Precipitation	Effective and reliable; conventional technology. Requires sludge disposal.	Readily implementable.	High capital, moderate O&M.
		Ion exchange	Effective and reliable; proper pretreatment required.	Readily implementable.	High capital, high O&M.
	Offsite treatment	POTW	Effectiveness and reliability require pilot test to determine.	Readily implementable, permit required.	Moderate capital, low O&M.
		RCRA facility	Effective and reliable treatment; transportation required.	Nearest RCRA facility 250 miles away.	High transportation cost.
	Onsite discharge	Local stream	Effective and reliable.	Readily implementable, Permit required.	Low capital, very low O&M.
	Offsite discharge	POTW	Effective and reliable.	Permit required.	High capital, low O&M.
		Pipeline to river	Effective and reliable.	Permit required.	High capital, low O&M.

Figure 4-5. Evaluation of Process Options - Example.

later phases of the FS when alternatives are refined and evaluated on a sitewide basis.

If modeling of transport processes is undertaken during the alternative development and screening, phases of the FS to evaluate removal or collection technologies, and if many contaminants are present at the site, it may be necessary to identify indicator chemicals, as is often done for the baseline risk assessments, to simplify the analysis. Typically, indicator chemicals are selected on the basis of their usefulness in evaluating potential effects on human health and the environment. Commonly selected indicator chemicals include those that are highly mobile and highly toxic.

4.2.5.2 Implementability Evaluation

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. As discussed in Section 4.2.4, technical implementability is used as an initial screen of technology types and process options to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology.

4.2.5.3 Cost Evaluation

Cost plays a limited role in the screening of process options. Relative capital and O&M costs are used rather than detailed estimates. At this stage in the process, the cost analysis is made on the basis of engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type. As discussed in Section 4.3, the greatest cost consequences in site remediation are usually associated with the degree to which different general technology types (i.e., containment, treatment, excavation, etc.) are used. Using different process options within a technology type usually has a less significant effect on cost than does the use of different technology types.

4.2.6 Assemble Alternatives

In assembling alternatives, general response actions and the process options chosen to represent the various technology types for each medium or operable unit are combined to form alternatives for the site as a whole. As discussed in Section 4.1.2.1, appropriate treatment and containment options should

be developed. To assemble alternatives, general response actions should be combined using different technology types and different volumes of media and/or areas of the site. Often more than one general response action is applied to each medium. For example, alternatives for remediating soil contamination will depend on the type and distribution of contaminants and may include incineration of soil from some portions of the site and capping of others.

For sites at which interactions among media are not significant (i.e., source control actions will not affect ground-water or surface-water responses) the combination of medium-specific actions into site wide alternatives can be made later in the FS process, either after alternatives have been screened or prior to conducting the comparative analysis of alternatives. For example, if media interactions are not of concern, an FS might describe three source control options, three soil remediation options, and four ground-water remediation options, (instead of developing numerous comprehensive sitewide alternatives). Although this approach permits greater flexibility in developing alternatives and simplifies the analyses of sitewide alternatives, it may involve greater effort in developing and analyzing medium-specific options.

Figure 4-6 illustrates how general response actions may be combined to form a range of sitewide alternatives. For this relatively simple example, the two media of interest are soil and ground water. The range of alternatives developed include a no-action alternative (alternative 1); a limited action alternative (alternative 2); source containment options with and without ground water treatment (alternatives 3 and 4); and three alternatives that employ various levels of source treatment, with ground-water collection and treatment (alternatives 5, 6, and 7).

Although not shown in this example, a description of each alternative should be included in the FS report. For the alternatives presented in Figure 4-6, such descriptions would include the locations of areas to be excavated or contained, the approximate volumes of soil and/or ground water to be excavated and collected, the approximate locations of interceptor trenches, the locations of potential city water supply hook-ups, the locations of connections to the local publicly owned treatment works (POTW), management options for treatment residuals, and any other information needed to adequately describe the alternative and document the logic behind the assembly of general response actions into specific remedial action alternatives. In describing alternatives, it may be useful to note those process options that were not screened out and that are represented by those described in the alternative.

General Response Action			1 No Action	2 Limited Action	3 Source Containment; No GW Controls	4 Source Containment; GW Collection, Pretreatment, POTW	5 In Situ Stabilization, Cap; GW Collection, Pretreatment, POTW	6 Biodegradation, Cap; GW Collection, Pretreatment, POTW	7 Incineration; GW Collection, Pretreatment, POTW
Medium	Technology Type	Area or Volume							
Soil	Access Restrictions (Fencing)			•					
	Excavation								•
					•	•			
	Disposal	Onsite RCRA Landfill			•				
		Offsite RCRA Landfill				•			•
	Treatment Onsite	In Situ Stabilization					•		
		Bioremediation To 10 ⁻⁴						•	
Ground Water ^a	Incineration Offsite								•
	Capping	All (Remaining) Soil Above 10 ⁻⁶			•	•	•	•	
	Alternate Water Supply	All Residents In Affected Area		•	•	•	•		
	Monitoring	All Monitoring Wells Twice A Year	•	•	•	•	•	•	•
	Collection With Interceptor Trenches	All Water Above 10 ⁻⁴ Within 10 Yrs.				•	•		
		All Water Above 10 ⁻⁶ Within 20 yrs						•	•
	Treatment With Precipitation Onsite	Pretreatment				•	•	•	•
	Discharge	Offsite To POTW				•	•	•	•

^aThis is a conceptual example using the example of carcinogenic risk ranges; however, in general, when MCLs are available they will apply.

Figure 4-8. Assembling a range of alternative examples.

4.3 Alternatives Screening Process

4.3.1 Alternatives Definition

Before beginning screening, alternatives have been assembled primarily on medium-specific considerations and implementability concerns. Typically, few details of the individual process options have been identified, and the sizing requirements of

technologies or remediation timeframes have not been fully characterized (except for timeframes identified to develop ground-water action alternatives). Furthermore, interactions among media, which may influence remediation activities, have usually not been fully determined, nor have sitewide protectiveness requirements been addressed. Therefore, at this point in the process, such aspects of the alternatives may need to be further defined to

form the basis for evaluating and comparing the alternatives before their screening.

4.3.1.1 Specific Objectives

Alternatives are initially developed and assembled to meet a set of remedial action objectives for each medium of interest. During screening, the assembled alternatives should be evaluated to ensure that they protect human health and the environment from each potential pathway of concern at the site or those areas of the site being addressed as part of an operable unit. If more than one pathway is present, such as inhalation of airborne contaminants and ingestion of contaminants in ground water, the overall risk level to receptors should be evaluated. If it is found that an alternative is not fully protective, a reduction in exposure levels for one or more media will need to be made to attain an acceptable risk level.

In refining alternatives, it is important to note that protectiveness is achieved by reducing exposures to acceptable levels, but achieving these reductions in exposures may not always be possible by actually cleaning up a specific medium to these same levels. For example, protection of human health at a site may require that concentrations of contaminants in drinking water be reduced to levels that could not reasonably be achieved for the water supply aquifer; thus, protection could be provided by preventing exposures with the use of a wellhead treatment system. The critical selection of how risk reductions are to be achieved is part of the risk management decisionmaking process.

4.3.1.2 Define Media and Process Options

Alternatives should be defined to provide sufficient quantitative information to allow differentiation among alternatives with respect to effectiveness, implementability, and cost. Parameters that often require additional refinement include the extent or volume of contaminated material and the size of major technology and process options.

Refinement of volumes or areas of contaminated media is important at some sites at which ongoing releases from the source (or contaminated soils) significantly affect contaminant levels in other media (e.g., ground water) because such interactions may not have been addressed when alternatives were initially developed by grouping medium-specific response actions. If interactions among media appear to be important at a site, the effect of source control actions on the remediation levels or time frames for other media should be evaluated.

Figure 4-7 provides an example of such an analysis in which volatile organics in soil are migrating into an

underlying aquifer composed of unconsolidated materials. Using a model of transport processes at the site, the effect of different soil removal actions on ground-water remediation (using a specified extraction scheme) could be estimated. In this example, development of alternatives that consider ground water actions independent of soil removal (i.e., the no-soil-removal scenario) could result in underestimating the achievable remediation level or overestimating the time frame for ground-water remediation. This could result in an overestimation of the extraction and treatment requirements for technology processes for ground water. By evaluating soil and ground water actions together, the rates and volumes of ground water extraction to achieve the target remediation levels can be refined more accurately.

After the alternatives have been refined with respect to volumes of media, the technology process options need to be defined more fully with respect to their effectiveness, implementability, and cost such that differences among alternatives can be identified. The following information should be developed, as appropriate, for the various technology processes used in an alternative:

- Size and configuration of onsite extraction and treatment systems or containment structures - For media contaminated with several hazardous substances, it may be necessary to first determine which contaminant(s) impose the greatest treatment requirements; then size or configure accordingly. Similarly, for ground-water extraction technologies at sites with multiple ground-water contaminants, it may be necessary to evaluate which compounds impose the greatest limits on extraction technologies, either because of their chemical/physical characteristics, concentration, or distribution in ground water.
- Time frame in which treatment, containment, or removal goals can be achieved - The remediation time frame is often interdependent on the size of a treatment system or configuration of a ground-water extraction system. The time frame may be determined on the basis of specific remediation goals (e.g., attaining ground-water remediation goals in 10 years), in which case the technology is sized and configured to achieve this; the time frame may also be influenced by technological limitations (such as maximum size consideration, performance capabilities, and/or availability of adequate treatment systems or disposal capacity).
- Rates or flows of treatment - These will also influence the sizing of technologies and time frame within which remediation can be achieved.

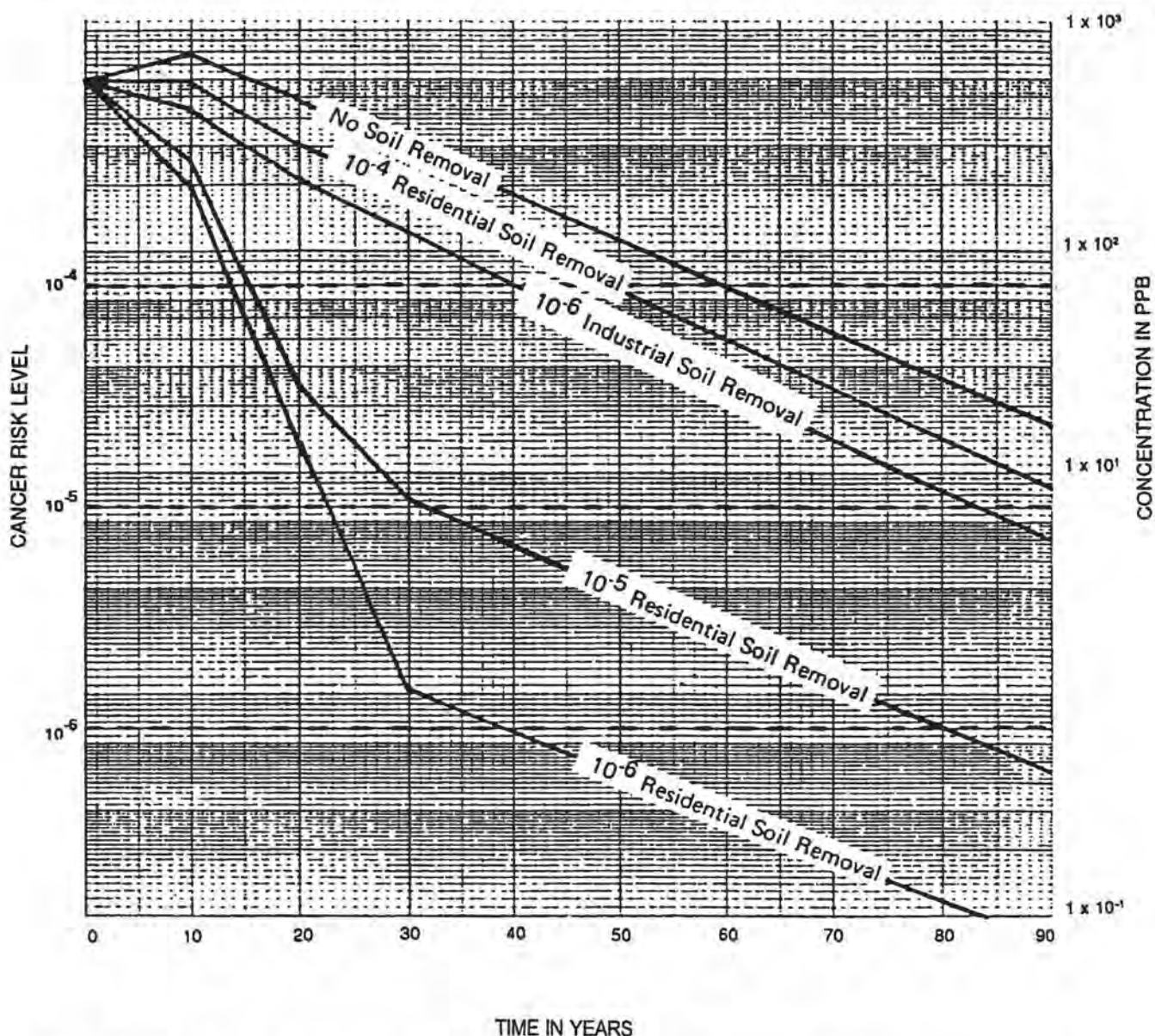


Figure 4-7. Time to achieve 10^{-4} to 10^{-6} risk level for a single-contaminant for ground water cleanup under various soil removal alternatives.

- Spatial requirements for constructing treatment or containment technologies or for staging construction materials or excavated soil or waste
- Distances for disposal technologies - These include approximate transport distances to acceptable offsite treatment and disposal facilities and distances for water pipelines for discharge to a receiving stream or a POTW.
- Required permits for offsite actions and imposed limitations - These include National Pollutant Discharge Elimination System (NPDES), pretreatment, and emission control requirements; coordination with local agencies and the public;

and other legal considerations. These may also encompass some action-, location-, and chemical-specific ARARs.

4.3.2 Screening Evaluation

Defined alternatives are evaluated against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo a more thorough and extensive analysis, alternatives will be evaluated more generally in this phase than during the detailed analysis. However, evaluations at this time should be sufficiently detailed to distinguish among alternatives. In addition, one should ensure

that the alternatives are being compared on an equivalent basis (i.e., definitions of treatment alternatives are approximately at the same level of detail to allow preparation of comparable cost estimates).

Initially, specific technologies or process options were evaluated primarily on the basis of whether or not they could meet a particular remedial action objective. During alternative screening, the entire alternative is evaluated as to its effectiveness, implementability, and cost.

During the detailed analysis, the alternatives will be evaluated against nine specific criteria and their individual factors rather than the general criteria used in screening. Therefore, individuals conducting the FS should be familiar with the nine criteria (see Section 6.2.2) at the time of screening to better understand the direction that the analysis will be taking. The relationship between the screening criteria and the nine evaluation criteria is conceptually illustrated in Figure 4-8.

It is also important to note that comparisons during screening are usually made between similar alternatives (the most promising of which is carried forward for further analysis); whereas, comparisons during the detailed analysis will differentiate across the entire range of alternatives. The criteria used for screening are described in the following sections.

4.3.2.1 Effectiveness Evaluation

A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment. Each alternative should be evaluated as to its effectiveness in providing protection and the reductions in toxicity, mobility, or volume that it will achieve. Both short- and long-term components of effectiveness should be evaluated; short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatment that decreases the inherent threats or risks associated with the hazardous material.

4.3.2.2 Implementability Evaluation

Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative, is used during screening to evaluate the combinations of process options with respect to conditions at a specific site. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete; it also

includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services and capacity, and the requirements for, and availability of, specific equipment and technical specialists.

The determination that an alternative is not technically feasible and is not available will usually preclude it from further consideration unless steps can be taken to change the conditions responsible for the determination. Typically, this type of "fatal flaw" would have been identified during technology screening, and the infeasible alternative would not have been assembled. Negative factors affecting administrative feasibility will normally involve coordination steps to lessen the negative aspects of the alternative but will not necessarily eliminate an alternative from consideration.

4.3.2.3 Cost Evaluation

Typically, alternatives will have been defined well enough before screening that some estimates of cost are available for comparisons among alternatives. However, because uncertainties associated with the definition of alternatives often remain, it may not be practicable to define the costs of alternatives with the accuracy desired for the detailed analysis (i.e., +50 percent to -30 percent).

Absolute accuracy of cost estimates during screening is not essential. The focus should be to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives will be sustained as the accuracy of cost estimates improves beyond the screening process. The procedures used to develop cost estimates for alternative screening are similar to those used for the detailed analysis; the only differences would be in the degree of alternative refinement and in the degree to which cost components are developed.

Cost estimates for screening alternatives typically will be based on a variety of cost-estimating data. Bases for screening cost estimates may include cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates as modified by site-specific information.

Prior estimates, site-cost experience, and good engineering judgments are needed to identify those unique items in each alternative that will control these comparative estimates. Cost estimates for items common to all alternatives or indirect costs (engineering, financial, supervision, outside contractor support, contingencies) do not normally warrant

**SCREENING
CRITERIA**

**NINE EVALUATION
CRITERIA**

**ROLE OF CRITERIA DURING
REMEDY SELECTION**

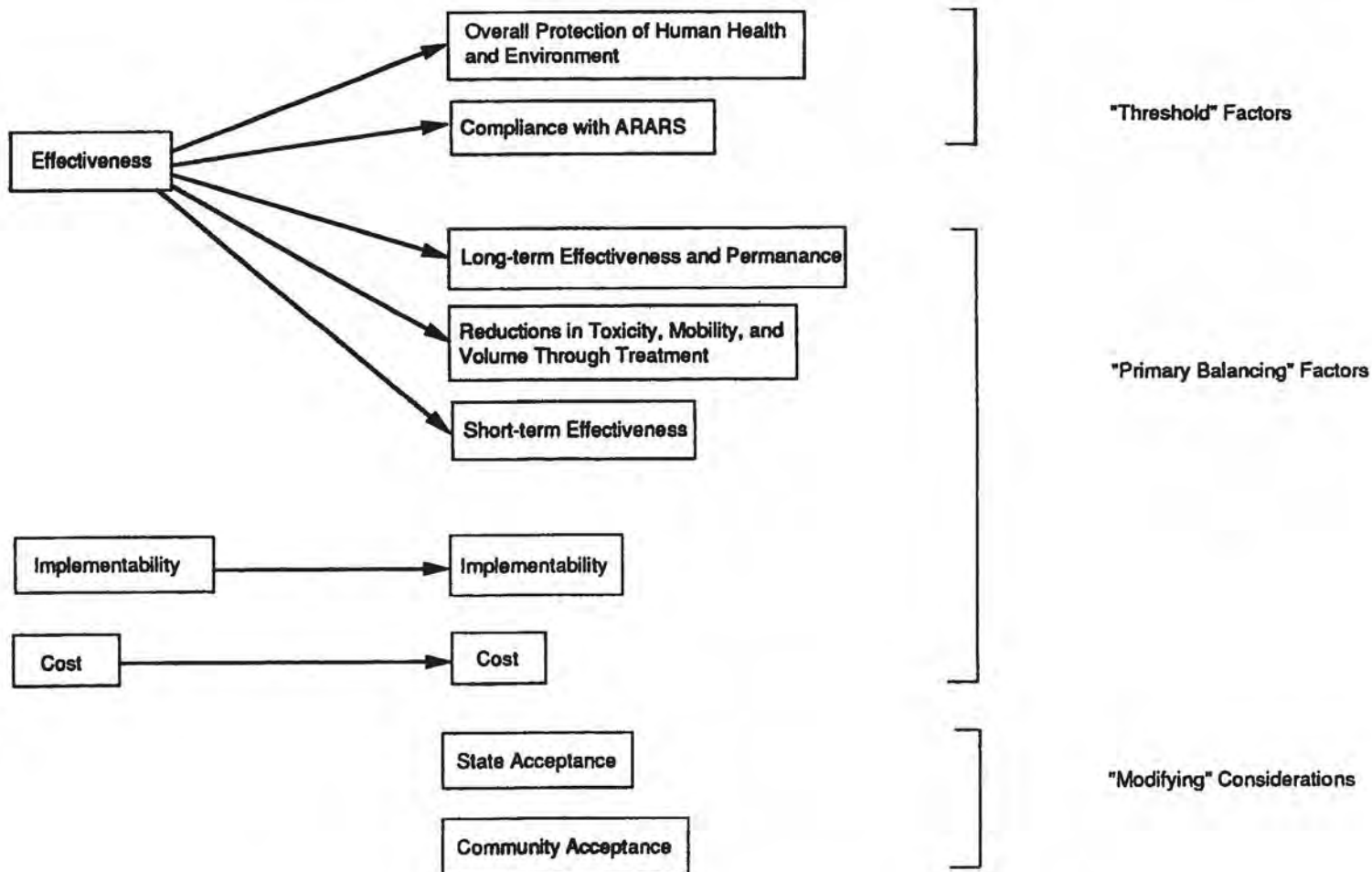


Figure 4-8. Relationship of Screening Criteria to the Nine Evaluation Criteria.

substantial effort during the alternative screening phase.

Both capital and O&M costs should be considered, where appropriate, during the screening of alternatives. The evaluation should include those O&M costs that will be incurred for as long as necessary, even after the initial remedial action is complete. In addition, potential future remedial action costs should be considered during alternative screening to the extent they can be defined. Present worth analyses should be used during alternative screening to evaluate expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative.

A more detailed discussion of cost evaluations is presented in Chapter 6.

4.3.2.4 Innovative Technologies

Technologies are classified as innovative if they are developed fully but lack sufficient cost or performance data for routine use at Superfund sites. In many cases, it will not be possible to evaluate alternatives incorporating innovative technologies on the same basis as available technologies, because insufficient data exist on innovative technologies. If treatability testing is being considered to better evaluate an innovative technology, the decision to conduct a test should be made as early in the process as possible to avoid delays in the RI/FS schedule.

Innovative technologies would normally be carried through the screening phase if there were reason to believe that the innovative technology would offer significant advantages. These advantages may be in the form of better treatment performance or implementability, fewer adverse impacts than other available approaches, or lower costs for similar levels of performance. A "reasonable belief" exists if indications from other full-scale applications under similar circumstances or from bench-scale or pilot-scale treatability testing supports the expected advantages.

4.3.3 Alternative Screening

4.3.3.1 Guidelines for Screening

Alternatives with the most favorable composite evaluation of all factors should be retained for further consideration during the detailed analysis. Alternatives selected for further evaluation should, where practicable, preserve the range of treatment and containment technologies initially developed. It is not a requirement that the entire range of alternatives originally developed be preserved if all alternatives in

a portion of the range do not represent distinct viable options.

The target number of alternatives to be carried through screening should be set by the project manager and the lead agency on a site-specific basis. It is expected that the typical target number of alternatives carried through screening (including containment and no-action alternatives) usually should not exceed 10. Fewer alternatives should be carried through screening, if possible, while adequately preserving the range of remedies. If the alternatives being screened are still medium-specific and do not address the entire site or operable unit, the number of alternatives retained for each specific medium should be considerably less than 10.

4.3.3.2 Selection of Alternatives for Detailed Analysis

Once the evaluation has been conducted for each of the alternatives, the lead agency and its contractor should meet with the support agency to discuss each of the alternatives being considered. This meeting does not correspond to a formal quality control review stage but provides the lead agency and its contractor with input from the support agency and serves as a forum for updating the support agency with the current direction of the FS.

The alternatives recommended for further consideration should be agreed upon at this meeting so that documentation of the results of alternative screening is complete; any additional investigations that may be necessary are identified; and the detailed analysis can commence.

Unselected alternatives may be reconsidered at a later step in the detailed analysis if similar retained alternatives continue to be evaluated favorably or if information is developed that identifies an additional advantage not previously apparent. This provides the flexibility to double check a previous decision or to review variations of alternatives being considered (e.g., consideration of other similar process options). However, it is expected that under most circumstances, once an alternative is screened out it will not be reconsidered for selection.

4.3.3.3 Post-screening Tasks

The completion of the screening process leads directly into the detailed analysis and may serve to identify additional investigations that may be needed to adequately evaluate alternatives. To ensure a smooth transition from the screening of alternatives to the detailed analysis, it will be necessary to identify and begin verifying action-specific ARARs and initiate treatability testing (if not done previously) and additional site characterization, as appropriate.

Although the consideration of action-specific ARARs begins earlier as process options are combined, the identification of action-specific ARARs will need to be more definitive as the alternatives become better defined. At the conclusion of screening, sufficient information should exist on the technologies and the most probable configurations of technologies so that the lead agency and support agency can better define and agree on action-specific ARARs. As with chemical-specific ARARs, action-specific ARARs should include all Federal requirements and any State requirements that either are more stringent than Federal ARARs or specify requirements where no Federal ARARs exist.

Once the field of alternatives has been narrowed, the technology processes of greatest interest can be identified. At this point, the need for treatability tests (if not identified earlier) can be determined for process options that will require additional data for detailed analysis. Although the results of treatability testing may not be used until the detailed analysis, they should be initiated as early in the process as possible to minimize any potential delays on the FS schedule. The type and scope of treatability tests depends on the expected data requirements for detailed analysis of alternatives. Factors involved in determining the need for and scope of treatability studies are discussed in Chapter 5.

In some cases, the need for additional site characterization may also be identified during the screening phase. Because the nature and extent of contamination is usually well defined at this time, additional field investigations should be conducted only to better define the effect of site conditions on the performance of the technology processes of greatest interest.

4.4 Community Relations During Alternative Development and Screening

The community relations activities implemented for site characterization may also be appropriate during the development of alternatives. Activities focus on providing information to the community concerning the development and screening of remedial alternatives and obtaining feedback on community interests and concerns associated with such alternatives. Community relations activities should be site- and community-specific and are usually stipulated in the community relations plan that is prepared during scoping activities. Community relations activities during the development of alternatives may include, but are not limited to, a fact sheet describing alternatives identified as potentially feasible, a workshop presenting citizens with the Agency's considerations for developing alternatives, briefings for local officials and concerned citizens on

alternatives under consideration, a small group meeting for citizens involved with the site, and news releases describing technologies being evaluated. It is important to note that public interest typically increases as the feasibility study progresses; and that the technical adequacy of a remedy does not ensure community acceptance. Therefore, the community relations activities should be planned and conducted to address such interest and potential concerns.

If alternatives are being developed concurrently with the RI site characterization, information on the screening of technologies and remedial alternative development should be included in public information materials and activities prepared during site characterization. If alternatives are developed after site characterization, additional community relations activities should be conducted. In general, community relations activities during alternative development and screening are most appropriate if citizens are significantly concerned over site conditions, and RI/FS activities that are being implemented at the site. The level of effort for community relations at this phase should be described in the community relations plan.

4.5 Reporting and Communication During Alternative Development and Screening

Although no formal report preparation is required during the development and screening of alternatives (except whatever routine administrative and project management tracking methods have been designated for use by the lead agency and its contractor(s))⁷, some form of written documentation of the methods, rationale, and results of alternative screening (e.g., graphical representation similar to Figures 4-5 and 4-6 or a technical memorandum) needs to be provided to the lead and support agencies. If a technical memorandum is prepared, it can serve as the basis for later development of the chapter(s) in the FS report that discusses the development and screening of alternatives.

Communication among the lead and support agencies and their contractor(s) is very important to obtain input and agreement on the technologies or processes and alternatives considered for implementation at the site. As shown in Table 4-2, communication should occur to facilitate the initial screening of technologies and process options, to agree on what additional site data may be needed, and to gain input and agreement on the choice of representative processes and combinations to be

⁷The RPM may require a written deliverable from the PRPs during alternative development and screening for a PRP-lead RI/FS.

used to assemble alternatives. In addition, the following key coordination points are required:

- The lead and support agencies should agree on the set of alternatives selected for detailed analysis.
- The lead and support agencies must coordinate identification of action-specific ARARs.
- The lead agency and its contractor are to evaluate the need for any additional investigations that may be needed before they conduct the detailed analysis.

For purposes of speed and efficiency, the preferred approach for the exchange of information is through meetings. However, other approaches that facilitate effective review and input (e.g., technical memorandums for review) may be used at the lead agency's discretion.

Because the final RI/FS report may eventually be subject to judicial review, the procedures for

evaluating, defining, and screening alternatives should be well documented, showing the rationale for each step. The following types of information should be documented in the final RI/FS report to the extent possible:

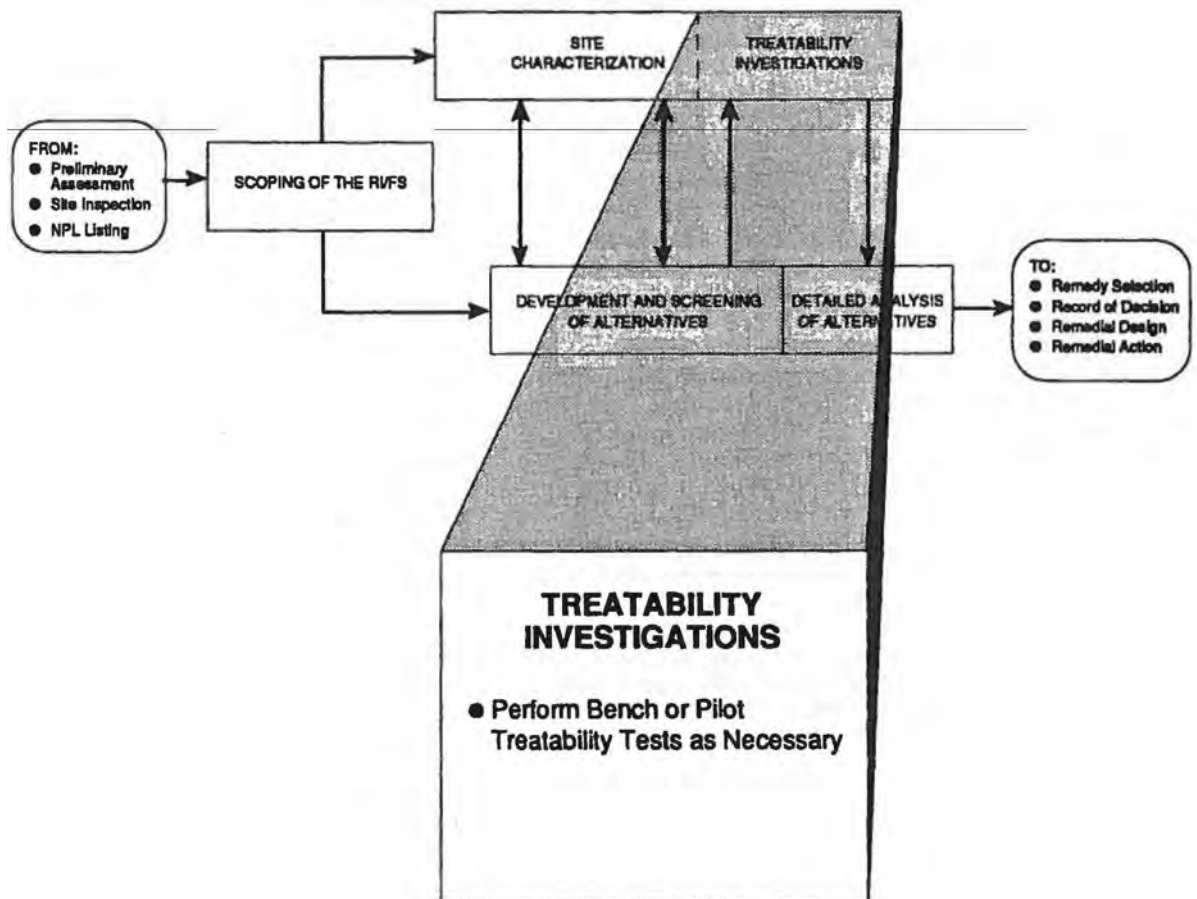
- Chemical- and/or risk-based remedial objectives associated with the alternative
- Modifications to any media-specific alternatives initially developed to ensure that risk from multiple-pathway exposures and interactions among source- and ground-water-remediation strategies are addressed
- Definition of each alternative including extent of remediation, volume of contaminated material, size of major technologies, process parameters, cleanup timeframes, transportation distances, and special considerations
- Notation of process options that were not initially screened out and are being represented by the processes comprising the alternative

Table 4-2. Reporting and Communication During Alternative Development and Screening

Information Needed	Purpose	Potential Methods for Information Provision
All potential technologies included for consideration	For lead agency and contractor to identify potential technologies; for lead agency to obtain support agency review and comment	Meeting Tech Memo Other
Need for additional field data or treatability studies	For lead agency and contractor to determine whether more field data or treatability tests are needed to evaluate selected technologies; for lead agency to obtain support agency review and comment	Meeting Tech Memo Other
Process evaluation and alternative development	For lead agency and contractor to communicate and reach agreement on technology screening and alternative development; for lead agency to obtain support agency review and comment	Meeting Tech Memo Other
Results of alternative screening (if conducted)	For lead agency and contractor to communicate and reach agreement on alternative screening; for lead agency to obtain support agency review and comment	Meeting Tech Memo Other
Identification of action-specific ARARs	For lead agency to obtain input from the support agency on action-specific ARARs	Meeting Letter Other
Need for additional investigation	For lead agency and contractor to determine whether additional investigations are needed to evaluate selected alternatives; for lead agency to obtain support agency review and comment	Meeting Tech Memo Other

CHAPTER 5

TREATABILITY INVESTIGATIONS



Chapter 5

Treatability Investigations

5.1 Introduction

As discussed earlier, the phased RI/FS process is intended to better focus the site investigation so that only those data necessary to support the RI/FS and the decision-making process are collected. Data needs are initially identified on the basis of the understanding of the site at the time the RI/FS is initially scoped. Therefore, initial sampling and testing efforts may be limited until a more complete understanding of the site allows subsequent sampling efforts to be better focused. As site information is collected during the RI and alternatives are being developed, additional data needs necessary to adequately evaluate alternatives during the detailed analysis are often identified. These additional data needs may involve the collection of site characterization data, as described in Chapter 3, or treatability studies to better evaluate technology performance. This chapter is intended to provide an overview of the types of treatability studies (i.e., bench scale, pilot scale) that may be used, their specific purposes, and important factors that need to be considered when contemplating their use.

5.1.1 Objectives of Treatability Investigations

Treatability studies are conducted primarily to achieve the following:

- Provide sufficient data to allow treatment alternatives to be fully developed and evaluated during the detailed analysis and to support the remedial design of a selected alternative
- Reduce cost and performance uncertainties for treatment alternatives to acceptable levels so that a remedy can be selected

5.1.2 Overview of Treatability Investigations

Treatability studies to collect data on technologies identified during the alternative development process are conducted, as appropriate, to provide additional information for evaluating technologies. The RI/FS contractor and the lead agency's RPM must review the existing site data and available information on technologies to determine if treatability investigations are needed. As discussed earlier, the need for

treatability testing should be identified as early in the RI/FS process as possible. A decision to conduct treatability testing may be made during project scoping if information indicates such testing is desirable. However, the decision to conduct these activities must be made by weighing the cost and time required to complete the investigation against the potential value of the information in resolving uncertainties associated with selection of a remedial action. In some situations a specific technology that appears to offer a substantial savings in costs or significantly greater performance capabilities may not be identified until the later phases of the RI/FS. Under such circumstances it may be advantageous to postpone completion of the RI/FS until treatability studies can be completed. Project managers will need to make such decisions on a case by case basis. In other situations, treatability investigations may be postponed until the remedial design phase.

The decision process for treatability investigations is shown conceptually in Figure 5-1 and consists of the following steps:

- Determining data needs
- Reviewing existing data on the site and available literature on technologies to determine if existing data are sufficient to evaluate alternatives
- Perform treatability tests, as appropriate, to determine performance, operating parameters, and relative costs of potential remedial technologies
- Evaluating the data to ensure that DQOs are met

5.2 Determination of Data Requirements

To the extent possible, data required to assess the feasibility of technologies should be gathered during the site characterization (e.g., moisture and heat content data should be collected if incineration of an organic waste is being considered). Because data requirements will depend on the specific treatment process and the contaminants and matrices being considered, the results of the site characterization will influence the types of alternatives developed and screened, which will in turn influence additional data

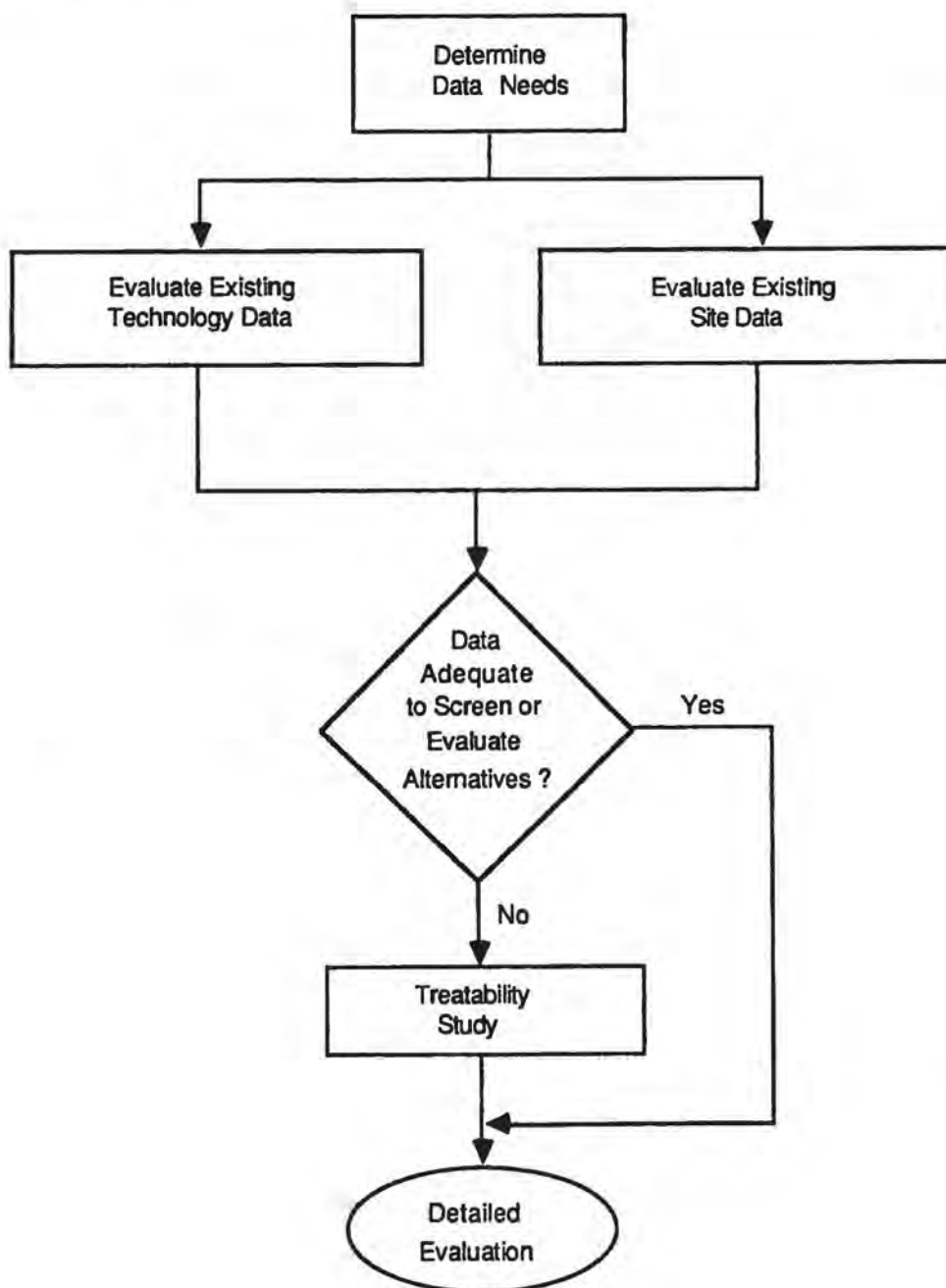


Figure 5-1. Treatability investigations.

needs. However, data collected during site characterization will not always be adequate for assessing the feasibility of remedial technologies, and, in fact, the need for detailed data from treatability tests may not become apparent until the initial screening of alternatives has been completed. A description of data requirements for selected technologies is presented in Table 5-1. The Technology Screening Guide for Treatment of CERCLA Soils and Sludges (U.S. EPA, September

1988) summarizes data needs for a larger number of available and innovative technologies. The Superfund Innovative Technology Evaluation (SITE) program is another source to assist with the identification of data needs and to obtain performance information on innovative technologies.

Additional data needs can be identified by conducting a more exhaustive literature survey than was originally conducted when potential technologies were initially

Table 5-1. Typical Data Requirements for Remediation Technologies

Technology	Waste Matrix	Example Data Required
Thermal Destruction	Soils	Moisture content Heat value Chlorine content Destruction efficiency
	Liquids	Heat value Concentration of metals Destruction efficiency
Air Stripping	Ground Water	Concentration of volatile contaminants. Concentration of non-volatile contaminants Contaminant removal efficiencies (obtainable from mathematical models)
Metal Hydroxide Precipitation	Ground Water	Metals concentration Contaminant removal efficiency Sludge generation rate and composition
In Situ Vapor Extraction	Soils	Soil type Particle size distribution. Concentration of volatile compounds Presence of non-volatile contaminants Contaminant removal efficiencies (usually requires bench- or pilot-scale work)

Note: Tables used in this outline are only partial examples.

being identified. The objectives of a literature survey are as follows:

- Determine whether the performance of those technologies under consideration have been sufficiently documented on similar wastes considering the scale (e.g., bench, pilot, or full) and the number of times the technologies have been used
- Gather information on relative costs, applicability, removal efficiencies, O&M requirements, and implementability of the candidate technologies
- Determine testing requirements for bench or pilot studies, if required

5.3 Treatability Testing

Certain technologies have been demonstrated sufficiently so that site-specific information collected during the site characterization is adequate to evaluate and cost those technologies without conducting treatability testing. For example, a ground-water investigation usually provides sufficient information from which to size a packed tower air stripper and prepare a comparative cost estimate. Other examples of when treatability testing may not be necessary include:

- A developed technology is well proven on similar applications.
- Substantial experience exists with a technology employing treatment of well-documented waste materials. (For example, air stripping or carbon adsorption of ground water containing organic compounds for which treatment has previously proven effective.)

- Relatively low removal efficiencies are required (e.g., 50 to 90 percent), and data are already available.

Frequently, technologies have not been sufficiently demonstrated or characterization of the waste alone is insufficient to predict treatment performance or to estimate the size and cost of appropriate treatment units. Furthermore, some treatment processes are not sufficiently understood for performance to be predicted, even with a complete characterization of the wastes. For example, often it is difficult to predict biological toxicity in a biological treatment plant without pilot tests. When treatment performance is difficult to predict, an actual testing of the process may be the only means of obtaining the necessary data. In fact, in some situations it may be more cost-effective to test a process on the actual waste than it would be to characterize the waste in sufficient detail to predict performance.

Treatability testing performed during an RI/FS is used to adequately evaluate a specific technology, including evaluating performance, determining process sizing, and estimating costs in sufficient detail to support the remedy-selection process. Treatability testing in the RI/FS is not meant to be used solely to develop detailed design or operating parameters that are more appropriately developed during the remedial design phase.

Treatability testing can be performed by using bench-scale or pilot-scale techniques, which are described in detail in the following sections. However, in general, treatability studies will include the following steps:

- Preparing a work plan (or modifying the existing work plan) for the bench or pilot studies

- Performing field sampling, and/or bench testing, and/or pilot testing
- Evaluating data from field studies, and/or bench testing, and/or pilot testing
- Preparing a brief report documenting the results of the testing

5.3.1 *Bench-Scale Treatability Studies*

Bench testing usually is performed in a laboratory, in which comparatively small volumes of waste are tested for the individual parameters of a treatment technology. These tests are generally used to determine if the "chemistry" of the process works and are usually performed in batch (e.g., "jar tests"), with treatment parameters varied one at a time. Because small volumes and inexpensive reactors (e.g., bottles or beakers) are used, bench tests can be used economically to test a relatively large number of both performance and waste-composition variables. It is also possible to evaluate a treatment system made up of several technologies and to generate limited amounts of residuals for evaluation. Bench tests are typically performed for projects involving treatment or destruction technologies. However, care must be taken in attempting to predict the performance of full-scale processes on the basis of these tests.

Bench-scale testing is useful for a developing technology, because it can be used to test for a wide variety of operating conditions.¹ In such cases, bench tests can also be used to determine broad operating conditions to allow optimization during additional bench or possibly larger-scale pilot tests to follow.

Bench-scale testing usually consists of a series of tests, with the results of the previous analysis determining the next set of conditions to evaluate. The first tests usually cover a broad range of potential operating conditions in order to narrow the conditions for subsequent tests. For example, pH is the most important parameter for hydroxide precipitation of heavy metals. An initial "screening" jar test might be performed in which the pH range is varied from 7 through 12 in whole pH units. After finding a minimum metals concentration at pH 9, additional testing could be performed at narrower pH intervals around 9. The initial screening tests need not be performed to the same high level of accuracy used in the final tests to predict treatment effectiveness.

¹Bench tests may also be conducted for well-developed and documented technologies that are being applied to a new waste.

Bench-scale testing can usually be performed over a few weeks or months, and the costs are usually only a small portion of the total RI/FS cost.

Bench-scale testing should be performed, as appropriate, to determine the following:

- Effectiveness of the treatment alternative on the waste (note that for some technologies bench-scale testing may not be sufficient to make a final effectiveness determination)
- Differences in performance between competing manufacturers (e.g., activated carbon adsorption isotherms, polymer jar tests)
- Differences in performance between alternative chemicals (e.g., alum versus lime versus ferric chloride versus sodium sulfide)
- Sizing requirements for pilot-scale studies (e.g., chemical feed systems)
- Screening of technologies to be pilot tested (e.g., sludge dewatering)
- Sizing of those treatment units that would sufficiently affect the cost of implementing the technology
- Compatibility of materials with the waste

The preplanning information needed to prepare for bench-scale treatability testing includes: a waste sampling plan; waste characterization; treatment goals (e.g., how clean or resistant to leaching does the waste need to be); data requirements for estimating the cost of the technology being evaluated (e.g., sufficient for an order of magnitude cost estimate (i.e., +50/-30 percent)); and information needed for procurement of equipment and analytical services.

5.3.2 *Pilot-Scale Treatability Studies*

Pilot studies are intended to simulate the physical as well as chemical parameters of a full-scale process; therefore, the treatment unit sizes and the volume of waste to be processed in pilot systems greatly increase over those of bench scale. As such, pilot tests are intended to bridge the gap between bench-level analyses and full-scale operation, and are intended to more accurately simulate the performance of the full-scale process.

Pilot units are designed as small as possible to minimize costs, yet large enough to get the data required for scaling up. Pilot units are usually sized to

minimize the physical and geometric effects of test equipment on treatment performance to simulate full-scale performance. Examples of these effects include mixing, wall effects, accurate settling data, and generation of sufficient residues (sludges, off gases, etc.) for additional testing (dewatering, fixation, etc.). Pilot units are operated in a manner as similar as possible to the operation of the full-scale system (i.e., if the full-scale system will be operated continuously, then the pilot system would usually be operated continuously).

In many instances, significant time is required to make a changeover in operating conditions of a pilot plant and get a reliable result of the change. Therefore, time and budget constraints often limit the ability to test a large number of operating conditions. Since pilot tests usually require large volumes of waste that may vary in characteristics, consideration should be given to performing tests on wastes that are representative of actual site conditions and full-scale operations (e.g., it may be necessary to blend or spike wastes to test all waste characteristics anticipated at the site and/or to conduct onsite tests using mobile laboratories).

In addition to the preplanning requirements for bench-scale tests, information needed to prepare for a pilot-scale treatability test includes:

- Site information that would affect pilot-test requirements (i.e., waste characteristics, power availability, etc.)
- Waste requirements for testing (i.e., volumes, pretreatment, etc.)
- Data requirements for technologies to be tested

Because substantial quantities of material may be processed in a pilot test and because of the material's hazardous characteristics, special precautions may be required in handling transport and disposal of processed waste. It may be necessary to obtain an agreement with a local sewer authority or cognizant State agencies or to obtain an NPDES permit for offsite discharge of treated effluent. Solid residuals must be disposed of properly offsite or stored onsite to be addressed as part of the remedial action.

5.4 Bench Versus Pilot Testing

Alternatives involving treatment or destruction technologies may require some form of treatability testing, if their use represents first-of-its-kind applications on unique or heterogeneous wastes.

Once a decision is made to perform treatability studies, the RI/FS contractor and lead agency remedial project manager will have to decide on the

type of treatability testing to use. This decision must always be made taking into account the technologies under consideration, performance goals, and site characteristics.

The choice of bench versus pilot testing is affected by the level of development of the technology. For a technology that is well developed and tested, bench studies are often sufficient to evaluate performance on new wastes. For innovative technologies, however, pilot tests may be required since information necessary to conduct full-scale tests is either limited or nonexistent.

Pilot studies are usually not required for well-developed technologies except when treating a new waste type or matrix that could affect the physical operating characteristics of a treatment unit. For example, incineration of fine sands or clay soils in a rotary kiln that has been developed for coarser solids can result in carryover of fine sands into the secondary combustion chamber.

During the RI/FS process, pilot-scale studies should be limited to situations in which bench-scale testing or field sampling of physical or chemical parameters provide insufficient information from which to evaluate an alternative (e.g., it is difficult to evaluate the ability of a rotary kiln incinerator to handle a new waste matrix using a bench-scale test). Pilot-scale tests may also be required when there is a need to investigate secondary effects of the process, such as air emissions, or when treatment residues (sludge, air emissions) are required to test secondary treatment processes.

Because of the time required to design, fabricate, and install pilot-scale equipment and to perform tests for a reasonable number of operating conditions, conducting a pilot study can add significant time and cost to the RI/FS. The decision to perform a pilot test should, therefore, be considered carefully and made as early in the process as possible to minimize potential delays to the FS.

To determine the need for pilot testing, the potential for improved performance or savings in time or money during the implementation of a technology should be balanced against the additional time and cost for pilot testing during the RI/FS. Technologies requiring pilot testing should also be compared to technologies that can be implemented without pilot testing. Innovative technologies should be considered if they offer the potential for more efficient treatment, destruction of the waste, or significant savings in time or money required to complete a remedial action.

The final decision as to how much treatability testing (or collection of additional data of any kind) should be undertaken involves balancing the value of the

additional data against increased cost, schedule delay, and level of allowable uncertainty in the remedy-selection process. Generally, one of the following choices must be made:

- Collect more data using treatability testing
- Provide additional safety factors in the remedial design to accommodate the uncertainties
- Proceed with the remedy selection, accepting the uncertainty and the potential cost and performance consequences

The final decision may be a combination of several of these choices. The lead agency's RPM must base the decision upon the characteristics of the site, the cost of the studies, and the uncertainties of proceeding without them.

Table 5-2 provides a comparison between bench and pilot studies, and Table 5-3 shows examples of bench and pilot testing programs.

5.4.1 Testing Considerations

Shipment of substantial volumes of contaminated material from a site for testing can prove to be difficult;² residual material not consumed in testing will need to be disposed of safely, and the disposal must be adequately documented. Therefore, the volume of materials to be tested offsite should be minimized to avoid related problems.

A second testing consideration is the possible difficulty of getting a representative sample of waste for treatability testing. For example, although ground-water samples collected from monitoring wells during site characterization may be available for testing treatment technologies, separate extraction wells may need to be used to produce the required ground-water flow patterns during remedial actions. Consequently, because the characteristics of ground water from extraction wells may be different from monitoring wells, representative waste samples may be unavailable until extraction wells are installed and pumped.

A similar concern arises when trying to obtain representative samples for testing the treatment of contaminated soil. Since the soil characteristics will vary both horizontally and vertically on the site it may not be possible to obtain a sample that fully represents full-scale conditions without blending or spiking.

² See 40 CFR parts 260 and 261 for specific details on treatability study sample exemptions.

5.4.2 Data Quality Objectives

The data quality required for analytical results of treatability tests is a key concern since it greatly affects the cost and time required for the analyses. Analytical levels and corresponding levels of quality are discussed in Chapter 2 of this guidance.

Since the results of bench and pilot studies are used to support selection of a remedial alternative, results of such studies will support the ROD and become part of the Administrative Record. Furthermore, results of treatability testing also may be used on other sites with similar characteristics. Therefore, procedures followed in testing should be well documented. Sampling and analyses for tests used to develop predictive results will need to be performed with the same level of accuracy and care that was used during the site characterization. Because cost and time required for analyses increase significantly with increased quality, potential savings can be derived by carefully determining the level(s) of data quality necessary for each analytical level required.

Table 5-4 presents the data quality usually required for the various analyses that may be performed during treatability investigations. Bench- and pilot-scale testing require some moderate and some high-quality data. Sufficient high-quality data are needed to document treatment performance of the technologies considered for further evaluation.

5.5 Treatability Test Work Plan

Laboratory testing can be expensive and time consuming. A well-written work plan is a necessary document if a treatability testing program is to be completed on time, within budget, and with accurate results. Preparation of a work plan provides an opportunity to run the test mentally and review comments before starting the test. It also reduces the ambiguity of communication between the lead agency's RPM, the contractor's project manager, the technician performing the test, and the laboratory technician performing the analyses on test samples. The treatability test work plan, which may be an amendment to the original work plan, if the need for the treatability tests was not identified until later in the process, or a separate one specifically for this phase. Regardless, the work plan should be reviewed and approved by the lead agency's RPM. The RPM and RI/FS contractor should determine the appropriate level of detail for the work plan since a detailed plan is not always needed and will require time to prepare and approve. In some situations the original work plan may adequately describe the treatability tests and a separate plan is not required (e.g., the need for treatability testing can be identified during the scoping phase if existing information is sufficient). Section

Table 5-2. Bench and Pilot Study Parameters

Parameter	Bench	Pilot
Purpose	Define process kinetics, material compatibility, impact of environmental factors, types of doses of chemicals, active mechanisms, etc.	Define design and operation criteria, materials of construction, ease of material handling and construction, etc.
Size	Laboratory or bench top	1-100% of full scale
Quantity of Waste and Materials Required	Small to moderate amounts	Relatively large amounts
Number of Variables That Can Be Considered	Many	Few (greater site-specificity)
Time Requirements	Days to weeks	Weeks to months
Typical Cost Range	0.5-2% of capital costs of remedial action	2-5% of capital costs of remedial action ¹
Most Frequent Location	Laboratory	Onsite
Limiting Considerations	Wall, boundary and mixing effects; volume effects; solids processing difficult to simulate; transportation of sufficient waste volume	Limited number of variables; large waste volume required; safety, health, and other risks; disposal of process waste material

¹Actual percentage cost of pilot testing will depend significantly on the total cost of the remedial action.

2.3.1 and Appendix B.2 provide additional information on work plan preparation.

5.5.1 Bench-Scale Treatability Work Plan

Table 5-5 provides a suggested work plan format for bench-scale testing; the various sections of the recommended format for the work plan are described below.

- **Project Description and Site Background** - Briefly describe the site and the types, concentrations, and distributions of contaminants of concern (concentrating on those for which the technology is being considered).
- **Remedial Technology Description** - Give a brief description of the technology(ies) to be tested.
- **Test Objectives** - Describe the purpose of the test, the data that are to be collected from the bench-scale test, and how the data will be used to evaluate the technology.
- **Specialized Equipment and Materials** - Describe unique equipment or reagents required for the test.
- **Experimental Procedures** - List specific steps to be performed in carrying out the bench-scale test; include volumes to be tested, descriptions of reactors to be employed, and materials needed (i.e., transfer by graduated cylinder 500 ml of waste to a 600 ml borosilicate glass beaker). Specify the accuracy of measurements by specifying standard laboratory glassware (e.g., a graduated cylinder has 5 percent accuracy whereas a pipet has 1 percent) and how samples are to be taken, which containers are to be used, which preservatives, etc.
- **Treatability Test Plan** - Include the variable conditions that are to be tested (e.g., a combination of 4 pH units and 5 doses of a chemical would produce 40 discrete tests [if replicated]); include parameters to be measured if they vary for different test conditions.
- **Analytical Methods** - The analytical method is dependent on test objectives, technology, waste, and other site factors. Survey available analytical methods and select the most appropriate. Describe analytical procedures or cite and reference standard procedures to be employed and define the level of accuracy needed for each of the analyses (perform initial testing to roughly determine optimal operating conditions; and use moderately accurate analytical techniques or analyses of only one or a few indicator compound(s) to greatly reduce the time and cost of these initial tests). After achieving best treatment, perform more complete and accurate testing to confirm the earlier results. Most bench tests require results in short order to allow varied test runs. Bench tests remote from the analyzing laboratory are difficult; therefore, analyze the duplicate final or check samples by the CLP, if necessary.
- **Data Management** - Testing procedures must be well documented, using bound notebooks, photographs, etc.; provisions need to be made for making backup copies of critical items of data. Describe the parameters to be measured, accuracy that the results are to be recorded to, and how these are to be recorded. Prepare a sample data sheet to be used in the bench test;

Table 5-3. Examples of Bench- and Pilot-Scale Testing Programs

Remedial Technology		Example Testing Programs
A. Air Pollution and Gas Migration Control	1. Capping	Bench: Soil density and bearing capacity vs. moisture content curves for proposed capping materials
	2. Dust Control	
B. Surface Water Controls	3. Vapor Collection and Treatment (carbon adsorption, air stripping, etc.)	Pilot: In-place soil densities; determination of gas withdrawal rates to control releases
	4. Diversion and Collection	Bench: Column testing of capping material compatibility with wastes present
C. Leachate and Ground-Water Controls	1. Containment barriers (slurry walls, grout curtains, etc.)	Pilot: In-place testing of geotextiles for control of erosion in grassed diversion ditches
	2. Ground-water pumping (well points, suction wells, etc.)	Bench: Determination of basicity and headloss vs. grain size of limestone materials for a treatment bed; determination of chemical compatibility of compacted clay with a leachate stream
D. Direct Waste Control	3. Subsurface collection drains	Pilot: In-place testing of a soil-type and grain-size specification and tile-drain configuration for a subsurface collection drain
	4. Permeable treatment beds (limestone, activated carbon)	
E. Soil and Sediment Containment and Removal	5. Capping	
	6. In Situ Treatment	Bench: Characterization of chemical and heat content of hazardous waste mixes; chemical, physical, and biological treatability studies to define rate constants, minimal-maximal loading rates and retention times, optimal pH and temperature, sludge generation rates and characteristics, and oxygen transfer characteristics; chemical type and dose rates; solids flux rate vs. solids concentration in sludge thickening systems; air/volume ratios for stripping towers
F. Land Disposal (landfill, land application)	7. Land Disposal (landfill, land application)	Pilot: Test burns to determine retention times, combustion-chamber and after-burner temperatures, destruction and removal efficiency, and fuel requirements for the incineration of a waste; endurance performance tests on membranes in reverse-osmosis units for ground-water treatment; in situ microbial-degradation testing of nutrient-dose and aeration rates to support in-place degradation of underground leak; evaluation of in-place mixing procedures for the solidification of a sludge in a lagoon

Table 5-4. Data Quality for Treatability Investigations

Analytical Level	Field Data	Bench/Pilot Data
Level II/ Level III	Feasibility screening	Testing to optimize operating conditions Monitoring Predesign sizing
Level IV/ Level V	Enforcement related evaluations and recommendations of alternatives	Establish design criteria establishing standards documenting performance in treatability studies to screen alternatives

include procedures to be employed to ensure that the results are protected from loss.

- *Data Analysis and Interpretation* - Describe in detail the procedures to be followed to reduce

Table 5-5. Suggested Format for Bench-Scale Work Plan

1.	Project Description and Site Background
2.	Remediation Technology Description
3.	Test Objectives
4.	Specialized Equipment and Materials
5.	Laboratory Test Procedures
6.	Treatability Test Plan Matrix and Parameters to Measure
7.	Analytical Methods
8.	Data Management
9.	Data Analysis and Interpretation
10.	Health and Safety
11.	Residuals Management

raw analytical data to a form useful for interpretation. The most helpful are methods of graphical interpretation based on known physical or chemical phenomena or common practice (e.g., plotting concentrations of metal remaining in solution versus pH or chemical dosage).

- **Health and Safety** - Modify the site health and safety plan as needed to account for waste handling and onsite testing operations.
- **Residual Management** - Describe the types of residuals anticipated and how they will be managed.

5.52 Pilot-Scale Treatability Work Plan

Table 5-6 contains a suggested work plan format. Although many of the sections are similar to those of the bench-scale work plan format, differences between the two are discussed below.

Table 5-6. Suggested Format for Pilot-Scale Work Plan

1.	Project Description and Site Background
2.	Remedial Technology Description
3.	Test Objectives
4.	Pilot Plant Installation and Startup
5.	Pilot Plant Operation and Maintenance Procedures
6.	Parameters to be Tested
7.	Sampling Plan
8.	Analytical Methods
9.	Data Management
10.	Data Analysis and Interpretation
11.	Health and Safety
12.	Residuals Management

- **Pilot Plant Installation and Startup** - For onsite pilot studies, describe the equipment required and method to be employed to get the equipment onsite and installed for the test period.
- **Pilot Plant Operation and Maintenance Procedures** - Describe the specific conditions under which the pilot test will be conducted. Pilot plants are normally run with relatively large volumes of waste to simulate full-scale operation and, therefore, waste characteristics usually have to be measured and operating controls adjusted (e.g., chemical feed rates) to match instructions

for startup and shutdown of the pilot plant. These specifications need to be included in the procedures list.

- **Parameters to be Tested** - List the operating conditions under which the pilot units are to be tested and the variations in control parameters that are to be evaluated (e.g., chemical feed rates or pH set points in a chemical precipitation test, or combustion temperature or gas residence time for an incinerator test).
- **Sampling Plan** - Describe locations and a schedule for samples to be taken from the pilot plant to determine performance; readings from in-line instruments, such as pH probes and sampling methods, containers, preservative, labeling, etc., should be included.
- **Health and Safety Plan** - Health and safety concerns are more critical during pilot tests because larger amounts of waste are involved and equipment is more complex. Equipment design and construction must comply with applicable code requirements.

5.6 Application of Results

5.6.1 Data Analysis and Interpretation

Following the completion of the treatability testing, results are reduced to a useful in accordance with the work plan. Data are interpreted on the technology's effectiveness, implementability, and/or cost, and anticipated results are compared with actual results. Graphical techniques are frequently used to present the results. Note that the level of reliability of the test results is usually based on the accuracy of the analytical methods employed.

Major differences between the anticipated and actual results may necessitate a modification of the work plan and retesting of the technology. In addition, raw-waste and effluent characteristics as well as by-products and emissions are evaluated to predict the ability of a full-scale unit to respond to variations in waste composition and meet performance specifications.

5.6.2 Use of the Results in the RI/FS Process

The purpose of a treatability evaluation is to provide information needed for the detailed analysis of alternatives and to allow selection of a remedial action to be made with a reasonable certainty of achieving the response objectives. All results are useful, even negative ones, because they can be used to eliminate technologies for further consideration. The results of bench and pilot tests can be used to ensure that conventional and innovative treatment or destruction technologies can be evaluated equally with non-

treatment alternatives during the detailed analysis phase of the FS. Secondary use of treatability results provides information for the subsequent detailed design of the selected remedial technology. Operating conditions must be carefully and completely documented so that this information can be used in the full-scale system.

The characteristics of residuals from the remedial technology should be determined during pilot testing. This information is useful in determining how the residuals can be handled or disposed and in predicting the effects of their disposal or emission. Information can often be collected to determine if the residuals should be considered hazardous wastes or disposed of as a non-hazardous waste.

5.6.3 Scaling up to Full-Scale

The study findings need to be evaluated for application of the technology at full-scale; the limitations of the bench- or pilot-scale test (size, wall, and boundary effects, etc.) need to be compensated for. Scale-up can be done on the basis of either previous experience with the treatment equipment with other wastes or established rules of similitude (used to relate physical laws to variations in scale) and mathematical models. This evaluation may include a sensitivity analysis to identify the key parameters and unknowns that can affect a full-scale system. The potential need for process modifications during design or operation must be considered.

5.7 Community Relations During Treatability Investigations

Treatability testing is potentially controversial within a community and, therefore, additional community relations activities may be required. An assessment of issues and concerns the community may have about planned treatability testing should be conducted. The assessment should augment the previously prepared community relations plan (if treatability testing was not part of the original work plan) and should include a discussion of any issues unique to the proposed procedures such as onsite pilot testing, transporting contaminated materials offsite, schedule changes resulting from conducting bench or pilot tests, disposal of residuals, uncertainties pertaining to innovative technologies, and the degree of development of the technology being tested.

Additional community relations implementation activities may be recommended in the assessment and may include a public meeting to explain the proposed bench or pilot test, a fact sheet describing

the technology and proposed test, a briefing to public officials about the treatability studies, and small group consultations with members of the community concerned about EPA's actions at the site. Other community relations activities may be needed, and consultations between the lead agency's project manager and the community relations coordinator should be used to establish the appropriate community relations activities.

5.8 Reporting and Communication During Treatability Investigations

Deliverables for the treatability investigations are listed in Table 5-7 and include the following:

- Revised work plans, as necessary, including bench and/or pilot tests
- Revised QAPP/FSP, as necessary
- Test results and evaluation report

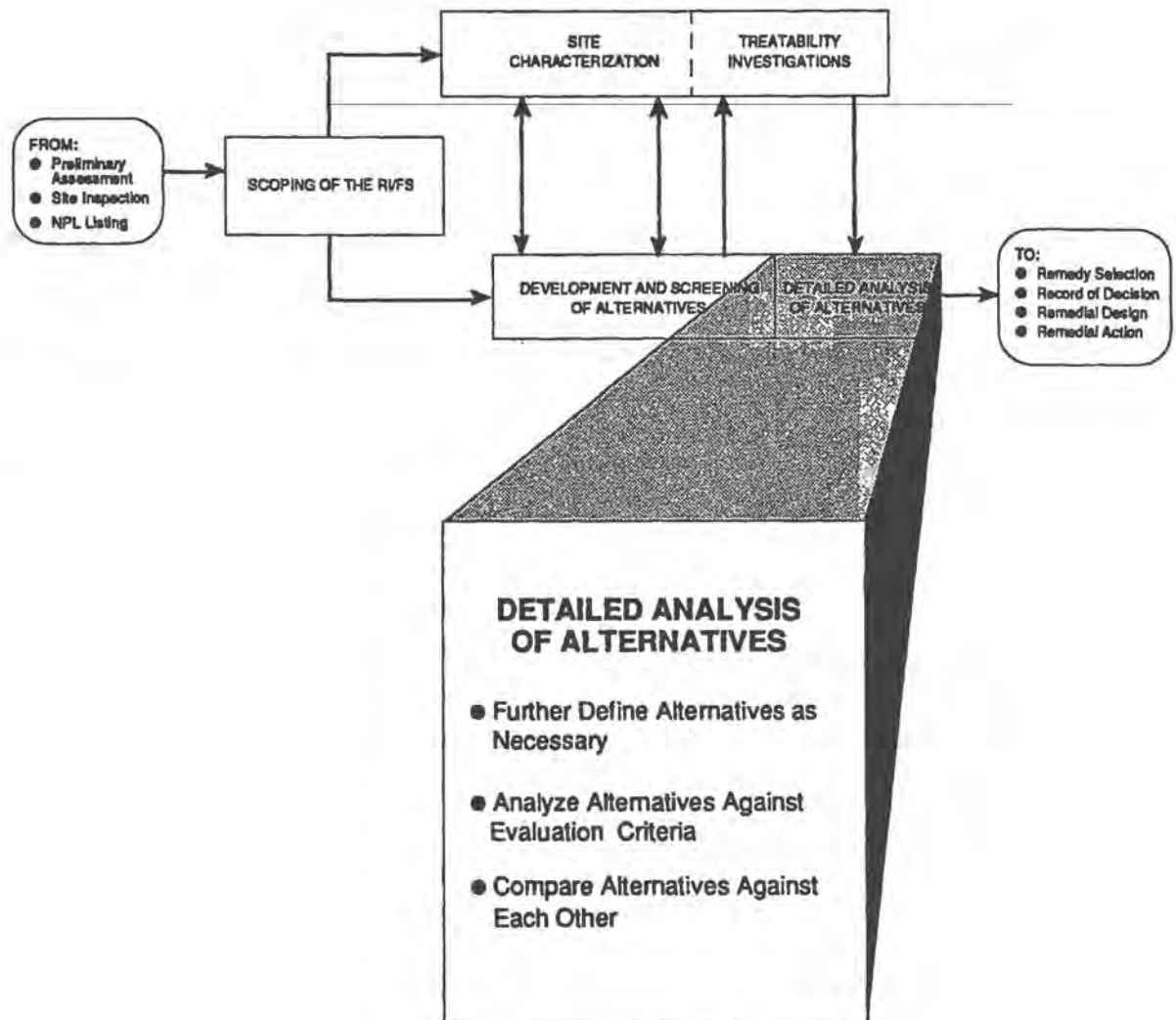
Table 5-7. Reporting and Communication During Treatability Investigations

Information Needed	Purpose	Potential Method for Information Provision
Need for Treatability Testing	For lead agency and contractor to determine whether more cost and performance data are needed to evaluate alternatives and select remedy; for lead agency to obtain support agency review and comment	Meeting Tech Memo
Approval of Site Data Collection or Treatability Testing	Obtain lead agency approval of treatability activities	QAPP (revised) FSP Treatability Study Work Plan

The treatability test evaluation report should describe the testing that was performed, the results of the tests, and an interpretation of how the results would affect the evaluation of the remedial alternatives being considered for the site. Effectiveness of the treatment technology for the wastes on the site should be presented. This report should also contain an evaluation of how the test results would affect treatment costs developed during the detailed analysis of alternatives (e.g., chemical requirements or settling rates required for effective treatment). Because the report may be used as an information source by other EPA and contractor staff at other sites with similar characteristics, it should be written clearly and concisely.

CHAPTER 6

DETAILED ANALYSIS OF ALTERNATIVES



Chapter 6

Detailed Analysis of Alternatives

6.1 Introduction

6.1.1 Purpose of the Detailed Analysis of Alternatives

The detailed analysis of alternatives consists of the analysis and presentation of the relevant information needed to allow decisionmakers to select a site remedy, not the decisionmaking process itself. During the detailed analysis, each alternative is assessed against the evaluation criteria described in this chapter. The results of this assessment are arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives is designed to provide decisionmakers with sufficient information to adequately compare the alternatives, select an appropriate remedy for a site, and demonstrate satisfaction of the CERCLA remedy selection requirements in the ROD.

The specific statutory requirements for remedial actions that must be addressed in the ROD and supported by the FS report are listed below. Remedial actions must:

- Be protective of human health and the environment
- Attain ARARs (or provide grounds for invoking a waiver)
- Be cost-effective
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation in the ROD as to why it does not

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions (§121 (b)(1)(A)). These statutory considerations include:

- A) the long-term uncertainties associated with land disposal;
- B) the goals, objectives, and requirements of the Solid Waste Disposal Act;
- C) the persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
- D) short- and long-term potential for adverse health effects from human exposure;
- E) long-term maintenance costs;
- F) the potential for future remedial action costs if the alternative remedial action in question were to fail; and
- G) the potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations listed above, and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analyses during the FS and for subsequently selecting an appropriate remedial action. The evaluation criteria with the associated statutory considerations are:

- Overall protection of human health and the environment
- Compliance with ARARs (B)
- Long-term effectiveness and permanence (A,B,C,D,F,G)
- Reduction of toxicity, mobility, or volume (B,C)
- Short-term effectiveness (D,G)
- Implementability

- Cost (E,F)
- State acceptance (relates to Section 121 (f))
- Community acceptance (relates to Sections 113 and 117)

6.1.2 The Context of Detailed Analysis

The detailed analysis of alternatives follows the development and screening of alternatives and precedes the actual selection of a remedy. As discussed in Chapter 4, the phases of the FS may overlap, with one beginning before another is completed, or they may vary in the level of detail based on the complexity or scope of the problem. The extent to which alternatives are analyzed during the detailed analysis is influenced by the available data, the number and types of alternatives being analyzed, and the degree to which alternatives were previously analyzed during their development and screening.

The evaluations conducted during the detailed analysis phase build on previous evaluations conducted during the development and screening of alternatives. This phase also incorporates any treatability study data and additional site characterization information that may have been collected during the RI.

The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed plan. Upon completion of the detailed analysis, the FS report, along with the proposed plan (and the RI report if not previously released), is submitted for public review and comment. The results of the detailed analysis supports the final selection of a remedial action and the foundation for the Record of Decision.

6.1.3 Overview of the Detailed Analysis

A detailed analysis of alternatives consists of the following components:

- Further definition of each alternative, if necessary, with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies
- An assessment and a summary profile of each alternative against the evaluation criteria
- A comparative analysis among the alternatives to assess the relative performance of each alternative with respect to each evaluation criterion

Figure 6-1 illustrates the steps in the detailed analysis process.

6.2 Detailed Analysis of Alternatives

6.2.1 Alternative Definition

Alternatives are defined during the development and screening phase (see Chapter 4) to match contaminated media with appropriate process options.¹ However, the alternatives selected as the most promising may need to be better defined during the detailed analysis. Each alternative should be reviewed to determine if an additional definition is required to apply the evaluation criteria consistently and to develop order-of-magnitude cost estimates (i.e., having a desired accuracy of + 50 percent to -30 percent). The information developed to define alternatives at this stage in the RI/FS process may consist of preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative. The following examples illustrate situations in which additional alternative definition is appropriate:

- The assumed sizing of the process option must be revised on the basis of results of treatability data (e.g., a taller air stripping tower with more packing is required to attain the treatment target).
- A different process option is to be used to represent the technology type on the basis of the results of treatability data (e.g., activated carbon rather than air stripping is required).
- The estimated volume of contaminated media has been refined on the basis of additional site characterization data.

As described in Chapter 4, alternatives can be developed and screened on a medium-specific or sitewide basis at the lead agency's discretion. Although it is acceptable to continue the evaluation of alternatives on a medium-specific basis during the detailed analysis, it is encouraged that alternatives be configured to present the decision-maker with a range of discrete options each of which addresses the entire site or operable unit being addressed by the FS.² Therefore, if separate alternatives have been developed for different areas or media of the site, it is recommended that they be combined during the detailed analysis phase to present comprehensive

¹This matching is done by identifying specific remedial action objectives (e.g., a risk-based cleanup target such as 1x10-s) and sizing process options to attain the objective (e.g., 10 ground-water extraction wells extracting 50 gpm each, activated carbon treatment for 500 gpm).

²This approach will better facilitate and simplify the nine criteria evaluation and preparation of a rationale for remedy selection in the Record of Decision.

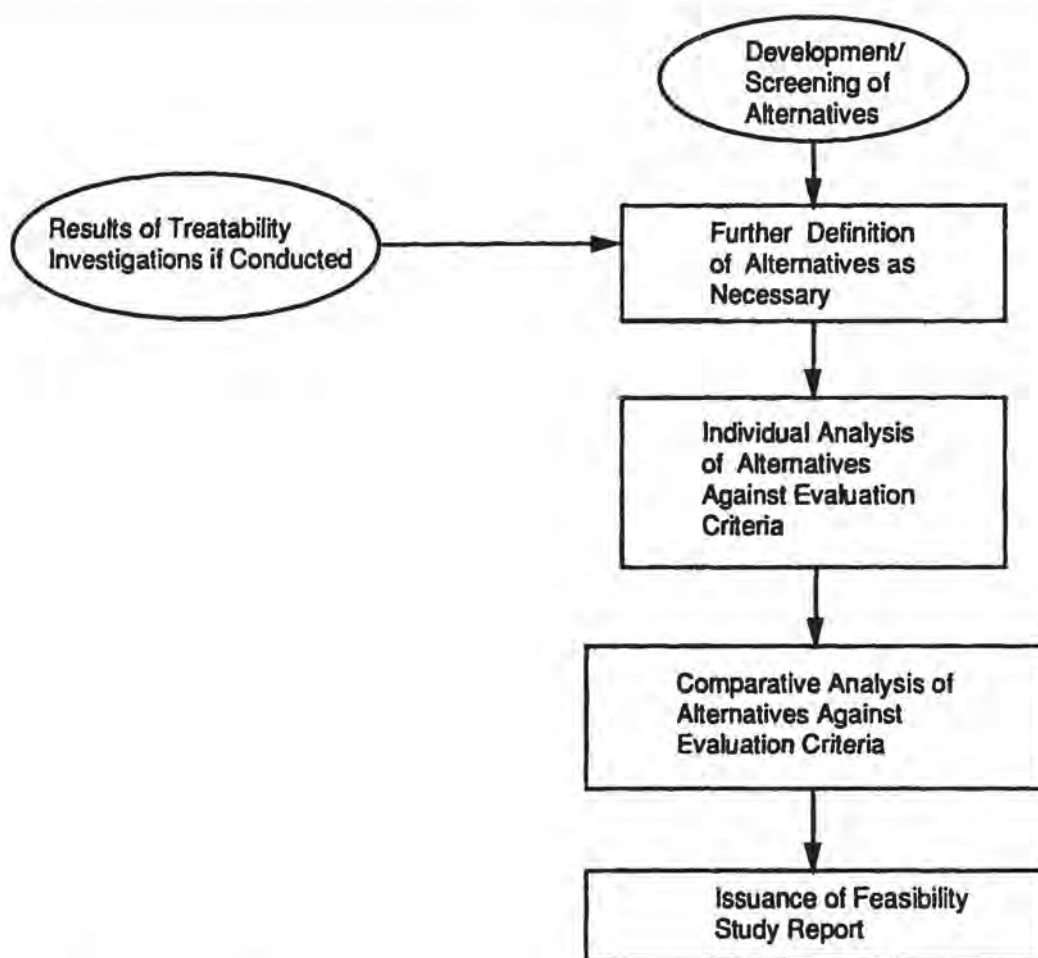


Figure 6-1. Detailed analysis of alternatives.

options addressing all potential threats posed by the site or that area being addressed by the operable unit. This can be accomplished either at the beginning of the detailed analysis or following the individual analysis when the alternatives are summarized and a comparative analysis is performed.

6.2.2 Over view of Evaluation Criteria

The detailed analysis provides the means by which facts are assembled and evaluated to develop the rationale for a remedy selection. Therefore, it is necessary to understand the requirements of the remedy selection process to ensure that the FS analysis provides the sufficient quantity and quality of information to simplify the transition between the FS report and the actual selection of a remedy. The analytical process described here has been developed on the basis of statutory requirements of CERCLA Section 121 (see Section 6.1.1); earlier program initiatives promulgated in the November 20, 1985, National Contingency Plan; and site-specific

experience gained in the Super-fund program. The nine evaluation criteria listed in Section 6.1.1 encompass statutory requirements and technical, cost, and institutional considerations the program has determined appropriate for a thorough evaluation.

Assessments against two of the criteria relate directly to statutory findings that must ultimately be made in the ROD. Therefore, these are categorized as threshold criteria in that each alternative must meet them.³ These two criteria are briefly described below:

- Overall Protection of Human Health and the Environment (described in Section 6.2.3.1) - The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

³The ultimate determination and declaration that these findings can be made of the selected remedy is contained in the ROD.

- Compliance with ARARs (described in Section 6.2.3.2) - The assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required and how it is justified. The assessment also addresses other information from advisories, criteria, and guidance that the lead and support agencies have agreed is "to be considered."

The five criteria listed below are grouped together because they represent the primary criteria upon which the analysis is based.

- Long-term Effectiveness and Permanence (described in Section 6.2.3.3) - The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.
- Reduction of Toxicity, Mobility, and Volume Through Treatment (described in Section 6.2.3.4) - The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.
- Short-term Effectiveness (described in Section 6.2.3.5) - The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met.
- Implementability (described in Section 6.2.3.6) - This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.
- Cost (described in Section 6.2.3.7) - This assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative.

The level of detail required to analyze each alternative against these evaluation criteria will depend on the type and complexity of the site, the type of technologies and alternatives being considered, and other project-specific considerations. The analysis should be conducted in sufficient detail so that decisionmakers understand the significant aspects of each alternative and any uncertainties associated with the evaluation (e.g., a cost estimate developed on the basis of a volume of media that could not be defined precisely).

The final two criteria, state or support agency acceptance and community acceptance, will be evaluated following comment on the RI/FS report and the proposed plan and will be addressed once a final decision is being made and the ROD is being prepared. The criteria are as follows:

- State (Support Agency) Acceptance (described in Section 6.2.3.8) - This assessment reflects the state's (or support agency's) apparent preferences among or concerns about alternatives.
- Community Acceptance (described in Section 6.2.3.9) - This assessment reflects the community's apparent preferences among or concerns about alternatives.

Each of the nine evaluation criteria has been further divided into specific factors to allow a thorough analysis of the alternatives. These factors are shown in Figure 6-2 and discussed in the following sections.

6.2.3 Individual Analysis of Alternatives

6.2.3.1 Overall Protection of Human Health and the Environment

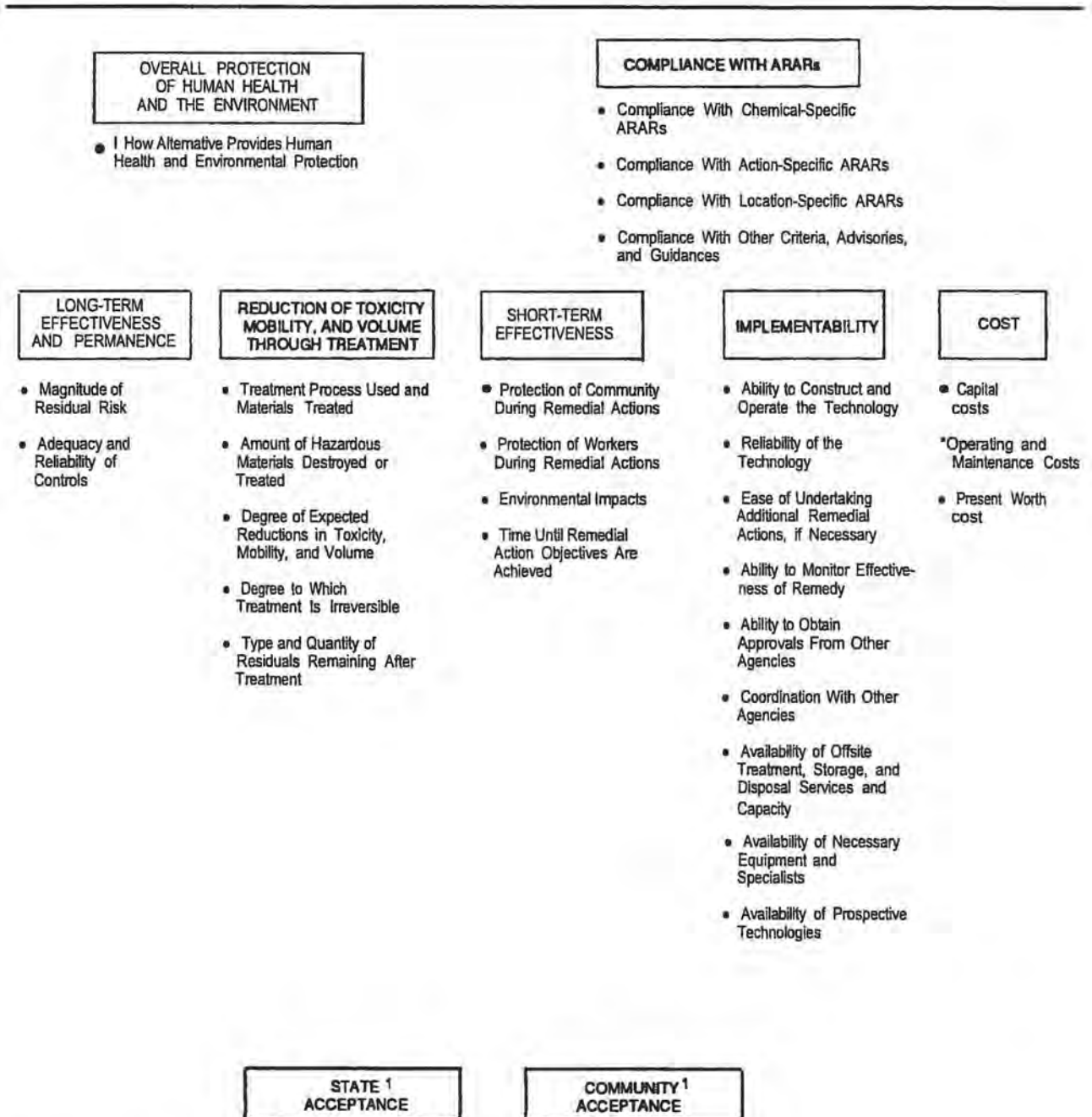
This evaluation criterion provides a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of the overall protectiveness of an alternative during the RI/FS should focus on whether a specific alternative achieves adequate protection and should describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation also allows for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

6.2.3.2 Compliance with ARARs

This evaluation criterion is used to determine whether each alternative will meet all of its Federal and State ARARs (as defined in CERCLA Section 121) that have been identified in previous stages of the RI/FS process. The detailed analysis should summarize which requirements are applicable or relevant and appropriate to an alternative⁴ and describe how the alternative meets these requirements. When an ARAR is not met, the basis for justifying one of the six waivers allowed under CERCLA (see Section 1.2.1.1) should be discussed.

⁴This effort will require input from the support agency.



¹These criteria are assessed following comment on the RI/FS report and the proposed plan.

Figure 6-2. Criteria for detailed analysis of alternatives.

The following should be addressed for each alternative during the detailed analysis of ARARs:⁶

⁶Other available information that is not an ARAR (e.g., advisories, criteria, and guidance) may be considered in the analysis if it helps to ensure protectiveness or is otherwise appropriate for use in a specific alternative. These TBC materials should be included in the detailed analysis if the lead and support agencies agree that their inclusion is appropriate.

- Compliance with chemical-specific ARARs (e.g., maximum contaminant levels) - This factor addresses whether the ARARs can be met, and if not, whether a waiver is appropriate.
- Compliance with location-specific ARARs (e.g., preservation of historic sites) - As with other ARAR-related factors, this involves a

consideration of whether the ARARs can be met or whether a waiver is appropriate.

- Compliance with action-specific ARARs (e.g., RCRA minimum technology standards) - It must be determined whether ARARs can be met or will be waived.

The actual determination of which requirements are applicable or relevant and appropriate is made by the lead agency in consultation with the support agency. A summary of these ARARs and whether they will be attained by a specific alternative should be presented in an appendix to the RI/FS report. A suggested format for this summary is provided in Appendix E of this guidance. More detailed guidance on determining whether requirements are applicable or relevant and appropriate is provided in the "CERCLA Compliance with Other Laws Manual" (U.S. EPA, Draft, May 1988).

6.2.3.3 Long-term Effectiveness and Permanence

The evaluation of alternatives under this criterion addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The following components of the criterion should be addressed for each alternative:

- Magnitude of residual risk - This factor assesses the residual risk remaining from untreated waste or treatment residuals at the conclusion of remedial activities, (e.g., after source/soil containment and/or treatment are complete, or after ground-water plume management activities are concluded). The potential for this risk may be measured by numerical standards such as cancer risk levels or the volume or concentration of contaminants in waste, media, or treatment residuals remaining on the site. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.
- Adequacy and reliability of controls - This factor assesses the adequacy and suitability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site. It may include an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels. This factor also addresses the long-term reliability of management controls for

providing continued protection from residuals. It includes the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathway and the risks posed should the remedial action need replacement.

Table 6-1 lists appropriate questions that may need to be addressed during the analysis of long-term effectiveness.

6.2.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

This evaluation would focus on the following specific factors for a particular remedial alternative:

- The treatment processes the remedy will employ, and the materials they will treat
- The amount of hazardous materials that will be destroyed or treated, including how the principal threat(s) will be addressed
- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude)
- The degree to which the treatment will be irreversible
- The type and quantity of treatment residuals that will remain following treatment
- Whether the alternative would satisfy the statutory preference for treatment as a principal element^a

In evaluating this criterion, an assessment should be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in

^aIt may be that alternatives for limited actions (e.g., provision of an alternative water supply) will not address principal threats within their narrow scope.

Table 6-1. Long-Term Effectiveness and Permanence

Analysis Factor	Specific Factor Considerations
Magnitude of residual risks	<ul style="list-style-type: none"> • What is the magnitude of the remaining risks? • What remaining sources of risk can be identified? How much is due to treatment residuals, and how much is due to untreated residual contamination? • Will a 5-year review be required?
Adequacy and reliability of controls	<ul style="list-style-type: none"> • What is the likelihood that the technologies will meet required process efficiencies or performance specifications? • What type and degree of long-term management is required? • What are the requirements for long-term monitoring? • What operation and maintenance functions must be performed? • What difficulties and uncertainties may be associated with long-term operation and maintenance? • What is the potential need for replacement of technical components? • What is the magnitude of the threats or risks should the remedial action need replacement? • What is the degree of confidence that controls can adequately handle potential problems? • What are the uncertainties associated with land disposal of residuals and untreated wastes?

combination. Table 6-2 lists typical questions that may need to be addressed during the analysis of toxicity, mobility, or volume reduction.

6.2.3.5 Short-term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until remedial response objectives are met (e.g., a cleanup target has been met). Under this criterion, alternatives should be evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The following factors should be addressed as appropriate for each alternative:

- Protection of the community during remedial actions - This aspect of short-term effectiveness addresses any risk that results from implementation of the proposed remedial action, such as dust from excavation, transportation of hazardous materials, or air-quality impacts from a stripping tower operation that may affect human health.
- Protection of workers during remedial actions - This factor assesses threats that may be posed to workers and the effectiveness and reliability of protective measures that would be taken.
- Environmental impacts - This factor addresses the potential adverse environmental impacts that may result from the construction and implementation of an alternative and evaluates the reliability of the available mitigation measures in preventing or reducing the potential impacts.
- Time until remedial response objectives are achieved - This factor includes an estimate of the time required to achieve protection for either the

entire site or individual elements associated with specific site areas or threats.

Table 6-3 lists appropriate questions that may need to be addressed during the analysis of short-term effectiveness.

6.2.3.6 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion involves analysis of the following factors:

- Technical feasibility
 - Construction and operation - This relates to the technical difficulties and unknowns associated with a technology. This was initially identified for specific technologies during the development and screening of alternatives and is addressed again in the detailed analysis for the alternative as a whole.
 - Reliability of technology - This focuses on the likelihood that technical problems associated with implementation will lead to schedule delays.
 - Ease of undertaking additional remedial action - This includes a discussion of what, if any, future remedial actions may need to be undertaken and how difficult it would be to implement such additional actions. This is particularly applicable for an FS addressing an interim action at a site where additional operable units may be analyzed at a later time.

Table 6-2. Reduction of Toxicity, Mobility, or Volume Through Treatment

Analysis Factor	Specific Factor Considerations
Treatment process and remedy	<ul style="list-style-type: none"> Does the treatment process employed address the principal threats? Are there any special requirements for the treatment process?
Amount of hazardous material destroyed or treated	<ul style="list-style-type: none"> What portion (mass, volume) of contaminated material is destroyed? What portion (mass, volume) of contaminated material is treated?
Reduction in toxicity, mobility, or volume	<ul style="list-style-type: none"> To what extent is the total mass of toxic contaminants reduced? To what extent is the mobility of toxic contaminants reduced? To what extent is the volume of toxic contaminants reduced?
Irreversibility of the treatment	<ul style="list-style-type: none"> To what extent are the effects of treatment irreversible?
Type and quantity of treatment residual	<ul style="list-style-type: none"> What residuals remain? What are their quantities and characteristics? What risks do treatment residuals pose?
Statutory preference for treatment as a principal element	<ul style="list-style-type: none"> Are principal threats within the scope of the action? Is treatment used to reduce inherent hazards posed by principal threats at the site?

Table 6-3. Short-Term Effectiveness

Analysis Factor	Basis for Evaluation During Detailed Analysis
Protection of community during remedial actions	<ul style="list-style-type: none"> What are the risks to the community during remedial actions that must be addressed? How will the risks to the community be addressed and mitigated? What risks remain to the community that cannot be readily controlled?
Protection of workers during remedial actions	<ul style="list-style-type: none"> What are the risks to the workers that must be addressed? What risks remain to the workers that cannot be readily controlled? How will the risks to the workers be addressed and mitigated?
Environmental impacts	<ul style="list-style-type: none"> What environmental impacts are expected with the construction and implementation of the alternative? What are the available mitigation measures to be used and what is their reliability to minimize potential impacts? What are the impacts that cannot be avoided should the alternative be implemented?
Time until remedial response objectives are achieved	<ul style="list-style-type: none"> How long until protection against the threats being addressed by the specific action is achieved? How long until any remaining site threats will be addressed? How long until remedial response objectives are achieved?

- Monitoring considerations - This addresses the ability to monitor the effectiveness of the remedy and includes an evaluation of the risks of exposure should monitoring be insufficient to detect a system failure.

- Administrative feasibility

- Activities needed to coordinate with other offices and agencies (e.g., obtaining permits for offsite activities or rights-of-way for construction)

- Availability of services and materials

- Availability of adequate offsite treatment, storage capacity, and disposal services

- Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources
- Availability of services and materials, plus the potential for obtaining competitive bids, which may be particularly important for innovative technologies
- Availability of prospective technologies

Table 6-4 lists typical questions that may need to be addressed during the analysis of implementability.

6.2.3.7 Cost

A comprehensive discussion of costing procedures for CERCLA sites is contained in the *Remedial Action*

Table 6-4. Implementability

Analysis Factor	Specific Factor Considerations
<i>Technical Feasibility</i>	
Ability to construct and operate technology	<ul style="list-style-type: none"> • What difficulties may be associated with construction? • What uncertainties are related to construction?
Reliability of technology	<ul style="list-style-type: none"> • What is the likelihood that technical problems will lead to schedule delays?
Ease of undertaking additional remedial action, if necessary	<ul style="list-style-type: none"> • What likely future remedial actions may be anticipated? • How difficult would it be to implement the additional remedial actions, if required?
Monitoring considerations	<ul style="list-style-type: none"> • Do migration or exposure pathways exist that cannot be monitored adequately? • What risks of exposure exist should monitoring be insufficient to detect failure?
<i>Administrative Feasibility</i>	
Coordination with other agencies	<ul style="list-style-type: none"> • What steps are required to coordinate with other agencies? • What steps are required to set up long-term or future coordination among agencies? • Can permits for offsite activities be obtained if required?
<i>Availability of Services and Materials</i>	
Availability of treatment, storage capacity, and disposal services	<ul style="list-style-type: none"> • Are adequate treatment, storage capacity, and disposal services available? • How much additional capacity is necessary? • Does the lack of capacity prevent implementation? • What additional provisions are required to ensure the needed additional capacity?
Availability of necessary equipment and specialists	<ul style="list-style-type: none"> • Are the necessary equipment and specialists available? • What additional equipment and specialists are required? • Does the lack of equipment and specialists prevent implementation? • What additional provisions are required to ensure the needed equipment and specialists?
Availability of prospective technologies	<ul style="list-style-type: none"> • Are technologies under consideration generally available and sufficiently demonstrated for the specific application? • Will technologies require further development before they can be applied full-scale to the type of waste at the site? • When should the technology be available for full-scale use? • Will more than one vendor be available to provide a competitive bid?

Costing Procedures Manual (U.S. EPA, September 1985). The application of cost estimates to the detailed analysis is discussed in the following paragraphs.

Capital Costs. Capital costs consist of direct (construction) and indirect (nonconstruction and overhead) costs. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, financial, and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. (Sales taxes normally do not apply to Superfund actions.) Costs that must be incurred in the future as part of the remedial action alternative should be identified and noted for the year in which they will occur. The distribution of costs over time will be a critical factor in making tradeoffs between capital-intensive technologies (including alternative treatment and destruction technologies)

and less capital-intensive technologies (such as pump and treatment systems).

Direct capital costs may include the following:

- Construction costs - Costs of materials, labor and equipment required to install a remedial action
- Equipment costs - Costs of remedial action and service equipment necessary to enact the remedy (these materials remain until the site remedy is complete)
- Land and site-development costs - Expenses associated with the purchase of land and the site preparation costs of existing property
- Buildings and services costs - Costs of process and nonprocess buildings, utility connections, purchased services, and disposal costs
- Relocation expenses - Costs of temporary or permanent accommodations for affected nearby

residents. (Since cost estimates for relocations can be complicated, FEMA authorities and EPA Headquarters should be consulted in estimating these costs.)

- Disposal costs - Costs of transporting and disposing of waste material such as drums and contaminated soils

Indirect capital costs may include:

- Engineering expenses - Costs of administration, design, construction supervision, drafting, and treatability testing
- License or permit costs - Administrative and technical costs necessary to obtain licenses and permits for installation and operation of offsite activities
- Startup and shakedown costs - Costs incurred to ensure system is operational and functional
- Contingency allowances - Funds to cover costs resulting from unforeseen circumstances, such as adverse weather conditions, strikes, or contaminant not detected during site characterization

Annual O&M Costs. Annual O&M costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. The following annual O&M cost components should be considered:

- Operating labor costs - Wages, salaries, training, overhead, and fringe benefits associated with the labor needed for post-construction operations
- Maintenance materials and labor costs - Costs for labor, parts, and other resources required for routine maintenance of facilities and equipment
- Auxiliary materials and energy - Costs of such items as chemicals and electricity for treatment plant operations, water and sewer services, and fuel
- Disposal of residues - Costs to treat or dispose of residuals such as sludges from treatment processes or spent activated carbon
- Purchased services - Sampling costs, laboratory fees, and professional fees for which the need can be predicted
- Administrative costs - Costs associated with the administration of remedial O&M not included under other categories
- Insurance, taxes, and licensing costs - Costs of such items as liability and sudden accidental

insurance; real estate taxes on purchased land or rights-of-way; licensing fees for certain technologies; and permit renewal and reporting costs

- Maintenance reserve and contingency funds - Annual payments into escrow funds to cover costs of anticipated replacement or rebuilding of equipment and any large unanticipated O&M costs
- Rehabilitation costs - Cost for maintaining equipment or structures that wear out over time
- Costs of periodic site reviews - Costs for site reviews that are conducted at least every 5 years if wastes above health-based levels remain at the site

The costs of potential future remedial actions should be addressed, and if appropriate, should be included when there is a reasonable expectation that a major component of the alternative will fail and require replacement to prevent significant exposure to contaminants. Analyses described under Section 6.2.3.3, "Long-term Effectiveness and Permanence," should be used to determine which alternatives may result in future costs. It is not expected that a detailed statistical analysis will be required to identify probable future costs. Rather, qualitative engineering judgment should be used and the rationale documented in the FS report.

Accuracy of Cost Estimates. Site characterization and treatability investigation information should permit the user to refine cost estimates for remedial action alternatives. It is important to consider the accuracy of costs developed for alternatives in the FS. Typically, these "study estimate" costs made during the FS are expected to provide an accuracy of + 50 percent to -30 percent and are prepared using data available from the RI. It should be indicated when it is not realistic to achieve this level of accuracy.

Present Worth Analysis. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life.

In conducting the present worth analysis, assumptions must be made regarding the discount rate and the period of performance. The Superfund program recommends that a discount rate of 5 percent before taxes and after inflation be assumed. Estimates of costs in each of the planning years are

made in constant dollars, representing the general purchasing power at the time of construction. In general, the period of performance for costing purposes should not exceed 30 years for the purpose of the detailed analysis.

Cost Sensitivity Analysis. After the present worth of each remedial action alternative is calculated, individual costs may be evaluated through a sensitivity analysis if there is sufficient uncertainty concerning specific assumptions. A sensitivity analysis assesses the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate, and effective life of an alternative can have on the estimated cost of the alternative. These assumptions depend on the accuracy of the data developed during the site characterization and treatability investigation and on predictions of the future behavior of the technology. Therefore, these assumptions are subject to varying degrees of uncertainty from site to site. The potential effect on the cost of an alternative because of these uncertainties can be observed by varying the assumptions and noting the effects on estimated costs. Sensitivity analyses can also be used to optimize the design of a remedial action alternative, particularly when design parameters are interdependent (e.g., treatment plant capacity for contaminated ground water and the length of the period of performance).

Use of sensitivity analyses should be considered for the factors that can significantly change overall costs of an alternative with only small changes in their values, especially if the factors have a high degree of uncertainty associated with them. Other factors chosen for analysis may include those factors for which the expected (or estimated) value is highly uncertain. The results of such an analysis can be used to identify worst-case scenarios and to revise estimates of contingency or reserve funds.

The following factors are potential candidates for consideration in conducting a sensitivity analysis:

- The effective life of a remedial action
- The O&M costs
- The duration of cleanup
- The volume of contaminated material, given the uncertainty about site conditions
- Other design parameters (e.g., the size of the treatment system)
- The discount rate (5 percent should be used to compare alternative costs, however, a range of 3 to 10 percent can be used to investigate uncertainties)

The results of a sensitivity analysis⁷ should be discussed during the comparison of alternatives. Areas of uncertainty that may have a significant effect on the cost of an alternative should be highlighted, and a rationale should be presented for selection of the most probable value of the parameter.

6.2.3.8 State (Support Agency) Acceptance

This assessment evaluates the technical and administrative issues and concerns the state (or support agency in the case of State-lead sites) may have regarding each of the alternatives. As discussed earlier, this criterion will be addressed in the ROD once comments on the RI/FS report and proposed plan have been received.

6.2.3.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As with state acceptance, this criterion will be addressed in the ROD once comments on the RI/FS report and proposed plan have been received.

6.2.4 Presentation of Individual Analysis

The analysis of individual alternatives with respect to the specified criteria should be presented in the FS report as a narrative discussion accompanied by a summary table. This information will be used to compare the alternatives and support a subsequent analysis of the alternatives made by the decision-maker in the remedy selection process. The narrative discussion should, for each alternative, provide (1) a description of the alternative and (2) a discussion of the individual criteria assessment.

The alternative description should provide data on technology components (use of innovative technologies should be identified), quantities of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. These descriptions, by clearly articulating the various waste management strategies for each alternative, will also serve as the basis for documenting the rationale of the applicability or relevance and appropriateness of potential Federal and State requirements. Therefore, the significant ARARs for each alternative should be identified and integrated into these discussions.

The narrative discussion of the analysis should, for each alternative, present the assessment of the alternative against each of the criteria.⁷ This discussion should focus on how, and to what extent, the various factors within each of the criteria are

⁷As noted previously, State and community acceptance will be addressed in the ROD once comments have been received on the RI/FS report and proposed plan.

addressed.^aThe uncertainties associated with specific alternatives should be included when changes in assumptions or unknown conditions could affect the analysis (e.g., the time to attain ground-water cleanup targets may be twice as long as estimated if assumptions made about aquifer characteristics for a specific ground-water extraction alternative are incorrect.) An example of an individual analysis is presented in Appendix F.

The FS also should include a summary table highlighting the assessment of each alternative with respect to each of the nine criteria. Appendix F provides an example of such a summary table.

6.2.5 Comparative Analysis of Alternatives

Once the alternatives have been described and individually assessed against the criteria, a comparative analysis should be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. This is in contrast to the preceding analysis in which each alternative was analyzed independently without a consideration of other alternatives. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decisionmaker must balance can be identified.

Overall protection of human health and the environment and compliance with ARARs will generally serve as threshold determinations in that they must be met by any alternative in order for it to be eligible for selection. The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost) will generally require the most discussion because the major tradeoffs among alternatives will most frequently relate to one or more of these five.

State and community acceptance will be addressed in the ROD once formal comments on the RI/FS report and the proposed plan have been received and a final remedy selection decision is being made.

6.2.6 Presentation of Comparative Analysis

The comparative analysis should include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion, and how reasonable variations of

^aThe factors presented in Tables 6-1 through 6-4 have been included to illustrate typical concerns that may need to be addressed during the detailed analysis. It will not be necessary or appropriate in all situations to address every factor in these tables for each alternative being evaluated. Under some circumstances, it may be useful to address other factors not presented in these tables to ensure a better understanding of how an alternative performs with respect to a particular criterion.

key uncertainties could change the expectations of their relative performance. An effective way of organizing this section is, under each individual criterion, to discuss the alternative(s) that performs the best overall in that category, with other alternatives discussed in the relative order in which they perform. If innovative technologies are being considered, their potential advantages in cost or performance and the degree of uncertainty in their expected performance (as compared with more demonstrated technologies) should also be discussed. Appendix F provides an example of a comparative analysis.

The presentation of differences among alternatives can be measured either qualitatively or quantitatively, as appropriate, and should identify substantive differences (e.g., greater short-term effectiveness concerns, greater cost, etc.). Quantitative information that was used to assess the alternatives (e.g., specific cost estimates, time until response objectives would be obtained, and levels of residual contamination) should be included in these discussions.

6.3 Post-RI/FS Selection of the Preferred Alternative

Following completion of the RI/FS, the results of the detailed analyses, when combined with the risk management judgments made by the decisionmaker, become the rationale for selecting a preferred alternative and preparing the proposed plan. Therefore, the results of the detailed analysis, or more specifically the comparative analysis, should serve to highlight the relative advantages and disadvantages of each alternative so that the key tradeoffs can be identified. It will be these key tradeoffs coupled with risk management decisions that will serve as the basis for the rationale and provide a transition between the RI/FS report and the development of a proposed plan (and ultimately a ROD). Specific guidance for preparing proposed plans and RODs is provided in the draft guidance on preparing Superfund decision documents.

6.4 Community Relations During Detailed Analysis

Site-specific community relations activities should be identified in the community relations plan prepared previously. While appropriate modifications of activities may be made to the community relations plan as the project progresses, the plan should generally be implemented as written to ensure that the community is informed of the alternatives being evaluated and is provided a reasonable opportunity to provide input to the decision-making process.

Often, a fact sheet is prepared that summarizes the feasible alternatives being evaluated. As appropriate, small group consultations or public meetings may be

held to discuss community concerns and explain alternatives under consideration. Public officials should be briefed and press releases prepared describing the alternatives. Other activities identified in the community relations plan should be implemented.

The objective of community relations during the detailed analysis is to assist the community in understanding the alternatives and the specific considerations the lead agency must take into account in selecting an alternative. In this way, the community is prepared to provide meaningful input during the upcoming public comment period.

6.5 Reporting and Communication During Detailed Analysis

Once the draft RI/FS report is prepared, the lead agency obtains the support agency's review and concurrence, the public's review and comment, and local agency and PRP input, if appropriate. The RI/FS report also provides a basis for remedy selection by EPA (or concurrence on State and Federal facility remedy) and documents the development and analysis of alternatives. A suggested FS report format is given in Table 6-5.

Table 6-5. Suggested FS Report Format

Executive Summary

1. Introduction
 - 1.1 Purpose and Organization of Report
 - 1.2 Background Information (Summarized from RI Report)
 - 1.2.1 Site Description
 - 1.2.2 Site History
 - 1.2.3 Nature and Extent of Contamination
 - 1.2.4 Contaminant Fate and Transport
 - 1.2.5 Baseline Risk Assessment
 2. Identification and Screening of Technologies
 - 2.1 Introduction
 - 2.2 Remedial Action Objectives -

Presents the development of remedial action objectives for each medium of interest (i.e., ground water, soil, surface water, air, etc.). For each medium, the following should be discussed:

 - Contaminants of interest
 - Allowable exposure based on risk assessment (including ARARs)
 - Development of remediation goals
 - 2.3 General Response Actions -

For each medium of interest, describes the estimation of areas or volumes to which treatment, containment, or exposure technologies may be applied.
 - 2.4 Identification and Screening of Technology Types and Process Options - For each medium of interest, describes:
 - 2.4.1 Identification and Screening of Technologies
 - 2.4.2 Evaluation of Technologies and Selection of Representative Technologies
 3. Development and Screening of Alternatives
 - 3.1 Development of Alternatives -

Describes rationale for combination of technologies/media into alternatives. Note: This discussion may be by medium or for the site as a whole.
 - 3.2 Screening of Alternatives (if conducted)
 - 3.2.1 Introduction
 - 3.2.2 Alternative 1
 - 3.2.2.1 Description
 - 3.2.2.2 Evaluation
 - 3.2.3 Alternative 2
 - 3.2.3.1 Description
 - 3.2.3.2 Evaluation
 - 3.2.4 Alternative 3
 4. Detailed Analysis of Alternatives
 - 4.1 Introduction
 - 4.2 Individual Analysis of Alternatives
 - 4.2.1 Alternative 1
 - 4.2.1.1 Description
 - 4.2.1.2 Assessment
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Appendix A

Interim Guidance on PRP Participation in the RI/FS Process*

I. Introduction

This memorandum sets forth the policy and procedures governing the participation of potentially responsible parties (PRPs) in the development of remedial investigations (RI) and feasibility studies (FS) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. This memorandum discusses:

- The initiation of enforcement activities including PRP searches and PRP notification;
- The circumstances in which PRPs may conduct the RI/FS;
- The development of enforceable agreements governing PRP RI/FS activities;
- Initiation of PRP RI/FS activities and oversight of the RI/FS by EPA;
- EPA control over PRP RI/FS activities; and
- PRP participation in Agency-financed RI/FS activities.

More detailed information regarding each of the above topics is included in Attachments I-4 of this appendix.

This document is consistent with CERCLA and EPA guidance in effect as of October 1988, and is intended to supersede the March 20, 1984 memorandum from Assistant Administrators Lee M. Thomas and Courtney M. Price entitled "Participation of Potentially Responsible Parties in Development of Remedial Investigations and Feasibility Studies Under CERCLA" (OSWER Directive No. 9835.1). Users of this guidance should consult the RI/FS Guidance or any relevant guidance or policies issued after distribution of this document before establishing

EPA/PRP responsibilities for conducting RI/FS activities. Additional guidance regarding procedures for EPA oversight activities will be available in the Office of Waste Program Enforcement's (OWPE) forthcoming "Guidance Manual on Oversight of Potentially Responsible Party Remedial Investigation and Feasibility Studies".

II. Background

Sections 104/122 of CERCLA provide PRPs with the opportunity to conduct the RI/FS when EPA determines (1) that the PRPs are qualified to conduct such activities and (2) they will carry out the activities in accordance with CERCLA requirements and EPA procedures. The Agency will continue its policy of early and timely PRP searches as well as early PRP notification and negotiation for RI/FS activities.

It is also the policy of EPA to encourage the early and active participation of PRPs in conducting RI/FS activities. EPA believes that early participation of PRPs in the remedial process will encourage PRP implementation of the selected remedy. PRP participation in RI/FS activities will ensure that they have a better and more complete understanding of the selected remedy, and thus will be more likely to agree on implementation of the remedy. Remedial activities performed by PRPs will also conserve Fund monies, thus making additional resources available to address other sites.

As part of the Agency's effort to encourage PRP participation in remedial activities, EPA will consider the PRPs' role in conducting RI/FS activities when assessing an overall settlement proposal for the remedial design and remedial action. For example, when the Agency performs a non-binding allocation of responsibility (NBAR), the Agency may consider previous PRP efforts and cooperation. This will provide an additional incentive for PRPs to be cooperative in conducting RI/FS activities.

* This memorandum was signed by the AA OSWER and released for distribution on May 16, 1988. Technical clarifications/updates have been made to this guidance for insertion into Appendix A of the "Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies" (October 1988-OSWER Directive No. 9355.3-01) (Referred to herein as the RI/FS Guidance).

¹The legal authority to enter into agreements with PRPs is found in CERCLA Section 122(a). This section then refers to response actions conducted pursuant to Section 104(b). For the purposes of this guidance, Sections 104/122 will be cited when referring to such authority.

Although EPA encourages PRP participation in conducting the RI/FS, the Agency and CERCLA impose certain conditions governing their participation. These conditions are intended to assure that the RI/FS performed by the PRPs is consistent with Federal requirements and that there is adequate oversight of those activities. These conditions are discussed both in Section III and Attachment I of this memorandum.

At the discretion of EPA, a PRP (or group of PRPs) may assume full responsibility for undertaking RI/FS activities pursuant to Sections 104/122 of CERCLA. The terms and conditions governing the RI/FS activities should be specified in an Administrative Order. The use of Administrative Orders is authorized in CERCLA Section 122(d)(3); they are the preferred type of agreement for RI/FS activities since they are authorized internally and therefore, may be negotiated more quickly than Consent Decrees. Before SARA, Administrative Orders were signed using the authorities of Section 106 of CERCLA. New provisions in SARA allow for Orders to be signed using the authorities of Sections 104/122; Section 104/122 Orders do not require EPA to make a finding of imminent and substantial endangerment.

RI/FS activities developed subsequent to the Administrative Order are set forth in a Statement of Work, which is then embodied or incorporated by reference into the Order. A Work Plan describing detailed procedures and criteria by which the RI/FS will be performed is developed by the PRPs and, after approval by EPA, should also be incorporated by reference into the Administrative Order.

It is the responsibility of the lead agency to ensure the quality of the effort if the PRPs assume responsibility for conducting the RI/FS. Therefore, EPA will establish oversight procedures and project controls to ensure that the response actions are consistent with CERCLA and the National Contingency Plan (NCP). Section 104(a)(1) of CERCLA mandates that no PRP be allowed to undertake an RI/FS unless EPA determines that the party(ies) conducting the RI/FS is qualified to do so. In addition, Section 104(a)(1) requires that a qualified party be contracted with or arranged for to assist in overseeing and reviewing the conduct of the RI/FS and, that the PRPs agree to reimburse EPA for the costs associated with the oversight contract or arrangement.

III. Initiation of Enforcement Activities

As part of effective management of enforcement activities, timely settlements for RI/FS activities are to be pursued. This includes conducting PRP searches early in the site discovery process and subsequent notification to all PRPs of their potential liability and of their opportunity to perform response activities.

Guidance on conducting timely and effective PRP searches is contained in the guidance manual, "Potentially Responsible Party Search Manual" (August 17, 1987 - OSWER Directive No. 9834.6).

EPA policy has been to notify PRPs of their potential liability for the planned response activities, to exchange information about the site, and to provide PRPs with an opportunity to undertake or finance the response activities themselves. In the past this has been accomplished by issuing a "general notice" letter to the PRPs. In addition to the use of the general notice letter, Section 122(e) of CERCLA now authorizes EPA to use "special notice" procedures, which for an RI/FS, establish a 60 to 90 day moratorium and formal negotiation period. The purpose of the moratorium is to provide time for formal negotiation between EPA and the PRPs for conduct of RI/FS activities. In particular, use of the special notice procedures triggers a 60 day moratorium on EPA conduct of the RI/FS. During the 60 day moratorium, if the PRPs provide EPA with a "good faith offer" to conduct or finance the RI/FS, the negotiation period can be extended to a total of 90 days. EPA considers a good faith offer to be a written proposal where the PRPs make a showing of their qualifications and willingness to conduct or finance the RI/FS. Minor deficiencies in the PRPs' initial submittals should not be grounds for a determination that the offer is not a good faith offer or that the PRPs are unable to perform the RI/FS.

To facilitate, among other things, PRP participation in the RI/FS process, Section 122(e)(1) requires the special notice letter to provide the names and addresses of other PRPs, the volume and nature of substances contributed by each PRP, and a ranking by volume of substances at the site, to the extent this information is available at the time of special notice. Regions are encouraged to release this information to PRPs when the notice letters are issued. To expedite settlements, Regions are also encouraged to give PRPs as much guidance as possible concerning the RI/FS process. It is appropriate to transmit to PRPs copies of important guidance documents such as the RI/FS Guidance, as well as model Administrative Orders and Statements of Work. A model Administrative Order can be found in the memorandum from Gene Lucero entitled, "Model CERCLA Section 106 Consent Order for an RI/FS" (January 31, 1985 - OSWER Directive No. 9835.5). This model order is currently being revised to reflect SARA requirements and will be forthcoming. A model Statement of Work has been included as Appendix C to the RI/FS Guidance, while a model Statement of Work for PRP-lead RI/FSs is currently being developed by OWPE. Other Regional and Headquarters guidance relating to technical issues may be given to PRPs, as well as examples of project plans (plans that must be developed prior to the conduct of the RI/FS) that are of high quality. A

description of the required project plans is included in Attachment II.

Although use of the special notice procedures is discretionary, Regions are encouraged to use these procedures in the majority of cases. If EPA decides not to employ the special notice procedures described in Section 122(e), the Agency will notify the PRPs in writing of such a decision, including an explanation as to why EPA believes the use of the special notice procedures is inappropriate. Additional information on the content of special notice letters, including the use of these notice provisions, can be found in the memorandum entitled "Interim Guidance on Notice Letters, Negotiations, and Information Exchange" (October 19, 1987 - OSWER Directive No. 9834.10).

Section 121 (f)(1) requires that the State be notified of PRP negotiations and that an opportunity for State participation in such negotiations be provided. In addition, Section 122(j)(1) requires that if a release or threat of release at the site in question may have resulted in damages to natural resources, EPA must notify the appropriate Federal or State Trustee and provide an opportunity for the Trustee to participate in the negotiations. To simplify the notification of Federal Trustees, the Agency intends to provide a list of projects in the Superfund Comprehensive Accomplishments Plan (SCAP) to the Trustees as notice to participate in the negotiations. In those cases where there is reason to believe that a significant natural resource will be affected, direct coordination with the Federal and/or State Trustee will be required.

IV. Conditions for EPA Involvement in, and PRP Initiation of, RI/FS Activities

Under Section 104(a)(1) EPA may authorize PRPs to conduct RI/FS activities at any site, provided the PRPs can do so promptly and properly and can meet the conditions specified by EPA for conducting the RI/FS. These conditions are discussed in Attachment I of this appendix and involve the scope of activities, the organization of the PRPs, and the PRPs' (and their contractors') demonstrated expertise. EPA encourages PRPs to conduct the RI/FS provided that the PRPs commit in an Order (or Consent Decree) under CERCLA Sections 104/122 (or Sections 106/122 for a Decree) to conduct a complete RI/FS to the satisfaction of EPA, under EPA oversight.² Oversight of RI/FS activities by the lead agency is required by Section 104(a)(1) and is intended to assure that the RI/FS is adequate for lead agency

²For a State-lead enforcement site the State is responsible for oversight unless otherwise specified in the agreement between the State and EPA. EPA should maintain communication with the State to ensure that the State is providing oversight of the remedial activities.

identification of an appropriate remedy, and that it will otherwise meet the Agency requirements of CERCLA, the NCP, and relevant Agency guidance. EPA will allow PRPs to conduct RI/FS activities and will provide review and oversight under the following general circumstances.

EPA's priority is to address those NPL sites that have been identified on the SCAP. The SCAP is an EPA management plan which identifies site- and activity-specific Superfund financial allocations for each quarter of the current fiscal year. When employing Section 122(e) notice procedures, EPA will notify PRPs of its intention to conduct RI/FS activities at NPL sites in a manner that allows at least 90 days notice before obligating the funds necessary to complete the RI/FS (see Section III of this guidance). During this time frame PRPs may elect to conduct the RI/FS, under the review and oversight of EPA. If the PRPs agree to conduct the RI/FS they must meet the conditions discussed in Attachment I. The scope and terms for conducting the studies are embodied in an Agreement; as mentioned in Section II, Administrative Orders are the preferred type of Agreement for RI/FS activities.

EPA will not engage in lengthy discussions with PRPs over whether the PRPs will conduct the RI/FS; rather, EPA will adhere to the time frames established by the Section 122 special notice provisions. In most instances, once Fund resources have been obligated to conduct the RI/FS, the PRPs will no longer be eligible to conduct the RI/FS activities at the site.

The actions described below are typically taken to initiate RI/FS activities:

- EPA develops a site-specific Statement of Work (SOW) in advance of the scheduled RI/FS start. This SOW is then provided to the PRPs along with a draft of the Administrative Order (or Consent Decree) at the initiation of negotiations. (PRPs may, with EPA approval, submit a single site plan that incorporates the elements of an SOW and a detailed Work Plan as a first deliverable once the Agreement has been signed. This combined site plan must clearly set forth the scope of the proposed RI/FS and would be incorporated into the Agreement in place of the SOW.)
- Final provisions of the SOW are negotiated with the Order.
- EPA determines whether the PRPs possess the necessary capabilities to conduct an RI/FS in a timely and effective manner (conducted simultaneously with other negotiations).
- EPA develops a Community Relations Plan specifying any activities that may be required of

the PRPs. (Community relations activities are discussed in Attachment II.)

- EPA determines contractor and staff resources required for oversight and initiates planning the necessary oversight requirements. This process may include preparing a Statement of Work, if a contractor is to develop an "oversight plan."
- EPA and PRPs identify and procure any necessary assistance.
- PRPs submit a Work Plan to EPA for Agency review and approval. The Work Plan must present the methodology and rationale for conducting the RI/FS as well as detailed procedures and requirements, if such procedures have not been set forth in the Agreement. This Work Plan, which in most instances is one of the first deliverables under the Order, is commonly incorporated into the Agreement following EPA approval.
- PRPs are responsible for obtaining access to the site; however, if access cannot be obtained, EPA, with the assistance of DOJ, will secure access subject to PRP reimbursement for the costs incurred in securing such access.

These standardized actions ensure that the scope of the RI/FS activities to be conducted by the PRPs, and the procedures by which the RI/FS is performed, are consistent with EPA policy and guidance. Additional actions may be required either for a technically complex site or for a site where a number of PRPs are involved. Regardless of the circumstances, the actions listed in this section should be negotiated as expeditiously as possible. Specific elements of these actions are discussed in Attachment II.

V. Development of the RI/FS Administrative Order or Consent Decree

The PRPs must respond to EPA's notice letter by either declining, within the time specified, to participate in the RI/FS, or by offering a good faith proposal to EPA for performing the RI/FS. Declining to participate in the RI/FS may be implied if the PRPs do not negotiate during the moratorium established by the notice letter. If the PRPs have declined to participate, or the time specified has lapsed, EPA will obligate funds for performing the RI/FS. If a good faith proposal is submitted, EPA will negotiate with the PRPs on the scope and terms for conducting the RI/FS.

The results of successful negotiations will, in most cases, be contained in an Administrative Order, or where the site is in litigation, in a Judicial Consent Decree entered into pursuant to Section 122(d) of CERCLA. Guidance for the development of an

Administrative Order is provided in OWPE's document "Administrative Order: Workshop and Guidance Materials" (September 1984), and in the memorandum from Gene Lucero entitled "Model CERCLA Section 106 Consent Order for an RI/FS" (January 31, 1985). (The latter guidance is currently being revised since the provisions in SARA allow for Orders to be signed using the authorities of Sections 104/122.)

An Administrative Order (or Consent Decree) will generally contain the scope of activities to be performed (either as a Statement of Work or Work Plan), the oversight roles and responsibilities, and enforcement options that may be exercised in the event of noncompliance (such as stipulated penalties). In addition to the above, the Agreement will typically include the following elements, as agreed upon by EPA, the PRPs, and other signatories to the Agreement.

- *Jurisdiction* - Describes EPA's authority to enter into Administrative Orders or Consent Decrees.
- *Parties bound* - Describes to whom the Agreement applies and is binding upon.
- *Purpose* - Describes the purpose of the Agreement in terms of mutual objectives and public benefit.
- *Findings of fact, determination, and conclusions of law* - Provides an outline of facts upon which the Agreement is based, including the fact that PRPs are not subject to a lesser standard of liability and will not receive preferential treatment from the Agency in conducting the RI/FS.
- *Notice to the State* - Verifies that the State has been notified of pending site activities.
- *Work to be performed* - Provides that PRPs submit project plans to the lead-agency for review and approval before commencing RI/FS activities. Project plans are those plans developed in order to effectively conduct the RI/FS project and include: a Work Plan, describing the methodology, rationale, and schedule of all tasks to be performed during the RI/FS; a Sampling and Analysis Plan, describing the field sampling procedures to be performed as well as the quality assurance procedures which will be followed for sampling and analysis (including a description of how the data gathered during the RI/FS will be managed) and the analytical procedures to be employed; and a Health and Safety Plan describing health and safety precautions to be exercised while onsite. (More information on the contents of these project plans can be found in Attachment II of this appendix.)

- *Compliance with CERCLA, the NCP, and Relevant Agency Guidance* - Specifies that the actions at a site will comply with the requirements of CERCLA, the NCP, and relevant Agency guidance determined to be appropriate for site remediation.
- *Reimbursement of costs* - Specifies that PRPs will assume all costs of performing the work required by the Agreement. In addition, this section commits PRPs to reimbursement of costs associated with oversight activities. This includes reimbursement for qualified party assistance in oversight, as required by Section 104(a)(1). This section should also specify the nature and kind of cost documentation to be provided and the process for billing and receiving payment.
- *Reporting* - Specifies the type and frequency of reporting that PRPs must provide to EPA. Normally the reporting requirements will, at a minimum, include the required project plans as well as those deliverables required by the RI/FS Guidance. Additional reporting requirements are left to the discretion of the Regions. That is, Regions may require additional deliverables such as interim reports on particular RI or FS activities.
- *Designated EPA, State, and PRP project coordinators* - Specifies that EPA, the State, and PRPs shall each designate a project coordinator.
- *Site access and data availability* - Stipulates that PRPs shall allow access to the site by EPA, the State, and oversight personnel. Access will be provided for inspection and monitoring purposes that in any way pertain to the work undertaken pursuant to the Order. In addition, access will be provided in the event of project takeover. This section also stipulates that EPA will be provided with all currently available data.
- *Record preservation* - Specifies that all records must be maintained by both parties for a minimum of 6 years after termination of the Agreement, followed by a provision requiring PRPs to offer the site records to EPA before destruction.
- *Administrative record requirements* - Provides that all information upon which the selection of remedy is based must be submitted to EPA in fulfillment of the administrative record requirements pursuant to Section 113 of CERCLA. (Additional information on administrative record requirements is contained in Attachment III.)
- *Dispute resolution* - Specifies steps to be taken if a dispute occurs. The Administrative Order states that with respect to all submittals and work performed, EPA will be the final arbiter, while the court is the final arbiter for a Consent Decree. (More information on dispute resolution can be found in Attachment IV of this appendix.)
- *Delay in performance/stipulated penalties* - Specifies EPA's authority to invoke stipulated penalties for noncompliance with Order or Decree provisions. Section 121 of CERCLA requires that Consent Decrees contain provisions for penalties in an amount not to exceed \$25,000 per day. In addition to stipulated penalties, Section 122(l) provides that Section 109 civil penalties apply for violations of Administrative Orders and Consent Decrees. Delays that endanger public health and/or the environment may result in termination of the Agreement and EPA takeover of the RI/FS. (More information on stipulated penalties can be found in the Office of Enforcement and Compliance Monitoring's (OECM) "Guidance on the Use of Stipulated Penalties in Hazardous Waste Consent Decrees" (September 21, 1987) and in Attachment IV of this appendix.)
- *Financial assurance* - Specifies that PRPs should have adequate financial resources or insurance coverage to address liabilities resulting from their RI/FS activities. When using contractors, PRPs should certify that the contractors have adequate insurance coverage or that contractor liabilities are indemnified.
- *Reservation of rights* - States that PRPs are not released from all CERCLA liability through compliance with the Agreement, or completion of the RI/FS. PRPs may be released from liability relating directly to RI/FS requirements, if PRPs complete the RI/FS activities to the satisfaction of EPA.
- *Other claims* - Provides that nothing in the Agreement shall constitute a release from any claim or liability other than, perhaps, for the cost of the RI/FS, if completed to EPA satisfaction. Also provides that nothing in the Agreement shall constitute preauthorization of a claim against the Fund under CERCLA. This section should also specify the conditions for indemnification of the U.S. Government.
- *Subsequent modifications/additional work* - Specifies that the PRPs are committed to perform any additional work or subsequent modifications which are not explicitly stated in the Work Plan, if EPA determines that such work is needed to enable the selection of an appropriate response action. (Attachment IV contains additional information on this clause.)

VI. Statement of Work and Work Plan

Based upon available models and guidance, the Region should present to the PRPs at the initiation of negotiations a Statement of Work (SOW) and draft Administrative Order. The SOW describes the broad objectives and general activities to be undertaken in the RI/FS. (The PRPs may develop the SOW if it is determined to be appropriate for a particular case.) Once the PRPs receive the SOW they develop a more detailed Work Plan, which should be incorporated by reference into the Order following EPA approval. The Work Plan expands the tasks described in the SOW and presents the rationale and methodology (including detailed procedures and schedules) for conducting the RI/FS. It should be noted that EPA, rather than the PRPs, may develop the work plan in the event of unusual circumstances.

VII. Review and Oversight of the RI/FS

To ensure that the RI/FS conforms to the NCP and the requirements of CERCLA, including Sections 104(a)(1) and 121, EPA will review and oversee PRP activities. Oversight is also required to ensure that the RI/FS will result in sufficient information to allow for remedy selection by the lead agency.

The oversight activities that EPA, the State, and other oversight personnel will be performing should be determined prior to the initiation of the RI/FS. Different mechanisms will be used for the review and oversight of different PRP products and activities. These mechanisms, and corresponding PRP activities, should be determined and if possible incorporated in the Order. Generally, the following oversight activities should be specified:

- Review of plans, reports, and records;
- Oversight of field activities (including maintenance of records and documentation);
- Meetings; and
- Special studies.

Section 104(a)(1) requires that the President contract with or arrange for a "qualified person" to assist in the oversight and review of the conduct of the RI/FS. EPA believes that qualified persons, for the purposes of overseeing RI/FS activities, are those firms or individuals with the professional qualifications, expertise, and experience necessary to provide assurance that the Agency is conducting meaningful and effective oversight of PRP activities. In this context, the qualified person generally will be either an ARCs, TES, or REM contractor. EPA employees, employees of other Federal agencies, State employees, or any other qualified person EPA

determines to be appropriate however, may be asked to perform the necessary oversight functions.

As part of the Section 104 requirements, PRPs are required to reimburse EPA for qualified party oversight costs. It is Agency policy to recover all response costs at a site including all costs associated with oversight. Additional guidance on oversight and project control activities is presented in Attachments III and IV, respectively.

VIII. Control of Activities

EPA will usually not intervene in a PRP RI/FS if activities are conducted in conformance with the conditions and terms specified by the Order. When deficiencies are detected, EPA will take immediate steps to correct the PRP activities. Deficiencies will be corrected through the use of the following activities: (1) identification of the deficiency; (2) demand for corrective measures; (3) use of dispute resolution mechanisms, where appropriate; (4) imposition of penalties; and if necessary, (5) PRP RI/FS termination and project takeover or judicial enforcement. These activities are described in detail in Attachment IV of this appendix.

IX. PRP Participation in Agency-Financed RI/FS Activities

PRPs that elect not to perform the RI/FS should be allowed an opportunity for involvement in a Fund-financed RI/FS. Private parties may possess technical expertise or knowledge about a site which would be useful in developing a sound RI/FS. Involvement by PRPs in the development of a Fund-financed RI/FS may also expedite remediation by identifying and satisfactorily resolving differences between the Agency and private parties.

Section 113(k)(2)(B) requires that interested persons, including PRPs, be provided an opportunity for participation in the development of the administrative record. PRP participation may include the submittal of information, relevant to the selection of remedy, for inclusion in the record and/or the review of record contents and submittal of comments on such contents.

The extent of additional PRP involvement will be left to the discretion of the Region and may include activities such as:

- Access to the site to observe sampling and analysis activities;
- Access to validated data and draft reports.

With respect to PRP access to a site, it is within the Regions' discretion to impose conditions based on

safety and other relevant considerations. To the extent that the Region determines that access is appropriate under the circumstances, PRPs must reimburse EPA for all identifiable costs incurred with the connection of the accesses afforded the PRPs, and must execute appropriate releases in favor of the EPA and its contractors. With respect to providing data, it should be noted that the Region is required to allow private citizens access to the same information that is provided to the PRPs. The Regions must therefore take this into consideration when determining the extent of the PRP's involvement in a Fund-financed RI/FS.

Aside from participation in the administrative record, which is a statutory requirement, the final decision whether to permit PRPs to participate in other aspects of the Fund-financed RI/FS (as well as the

scope of any participation) rests with the Regions. This decision should be based on the ability of PRPs to organize themselves so that they can participate as a single entity, and the ability of PRPs to participate without undue interference with or delay in completion of the RI/FS, and other factors that the Regions determine are relevant. The Region may terminate PRP participation in RI/FS development if unnecessary expenses or delays occur.

X. Contact

For further information on the subject matter discussed in this interim guidance, please contact Susan Cange (FTS 475-9805) of the Guidance and Oversight Branch, Office of Waste Program Enforcement.

Attachment I

Conditions for PRP Conduct of the RI/FS

Organization and Management

When several potentially responsible parties are involved at a site they must be able to organize themselves quickly into a single representative body to negotiate with EPA. To facilitate this negotiation process, EPA will make available the names and addresses of other PRPs, in accordance with the settlement provisions of CERCLA Section 122(e). Either a single PRP or an organized group of PRPs may assume responsibility for development of the RI/FS.

Scope of Activities

As part of the negotiation process PRPs must agree to follow the site-specific Statement of Work (SOW) as the basis for conducting an RI/FS. PRPs are required to submit an RI/FS Work Plan setting forth detailed procedures and tasks necessary to accomplish the RI/FS activities described in the SOW. EPA may approve reasonable modifications to the SOW and will reject any requests for modifications that are not consistent with CERCLA (as amended by SARA), the NCP, the requirements set forth in this guidance document, the RI/FS Guidance, or other relevant CERCLA guidance documents.

Demonstrated Capabilities

PRPs must demonstrate to EPA that they possess, or are able to obtain, the technical expertise necessary to perform all relevant activities identified in the SOW, and any amendments that may be reasonably anticipated to that document. In addition, PRPs must demonstrate that they possess the managerial expertise and have developed a management plan sufficient to ensure that the proposed activities will be properly controlled and efficiently implemented. PRPs must also demonstrate that they possess the financial capability to conduct and complete the RI/FS in a timely and effective manner. These capabilities are discussed briefly below.

- **Demonstrated Technical Capability**

PRPs should be required to demonstrate the technical capabilities of key personnel involved in executing the project. Personnel qualifications may be

demonstrated by submitting resumes and references. PRPs may demonstrate the capabilities of the firm that will perform the work by outlining their past areas of business, relevant projects and experience, and overall familiarity with the types of activities to be performed as part of the remedial investigation and feasibility study.

It is important that qualified firms be retained for performing RI/FS activities. Firms that do not have the necessary expertise for performing RI/FS studies may create unnecessary delays in the project and may create situations which further endanger public health or the environment. These situations may be created when PRP contractors submit insufficient project plans, submit deficient reports, or perform inadequate field work. Furthermore, excessive Agency oversight may be required in the event that an unqualified contractor performs the RI/FS; the Agency may have to significantly increase its workload by providing repeated reviews of project plans, reports, and oversight of field activities.

The PRPs must also demonstrate the technical capabilities of the laboratory chosen to do the analysis of samples collected during the RI/FS. If a non-CLP laboratory is selected, EPA may require a submission from the laboratory which provides a comprehensive statement of the laboratories' personnel qualifications, equipment specifications, security measures, and any other material necessary to prove the laboratory is qualified to conduct the work.

- **Demonstrated Management Capability**

PRPs must demonstrate that they have the administrative capabilities necessary for conducting the RI/FS in a responsible and timely manner. A management plan should be submitted to EPA either during negotiations or as a part of the Work Plan which includes a discussion of roles and responsibilities of key personnel. This management plan should include an RI/FS team organization chart describing responsibilities and lines of authority. Positions and responsibilities should be clearly related to technical and managerial qualifications. The PRPs should also demonstrate an understanding of effective communications, information management, quality

assurance, and quality control systems. PRPs usually procure the services of consultants to conduct the required RI/FS activities. The consultants must demonstrate, in addition to those requirements stated above, effective contract management capabilities.

- **Demonstrated Financial Capability**

The PRPs should develop a comprehensive and reasonable estimate of the total cost of anticipated RI/FS activities. EPA will decide on a case-by-case basis if the PRPs will be required to demonstrate that they have the necessary financial resources available and committed to conduct the RI/FS activities. The resources estimated should be adequate to cover the anticipated costs for the RI/FS as well as the costs for oversight, plus a margin for unexpected expenses. If, during the conduct of the RI/FS the net worth of the financial mechanism providing funding for the RI/FS is reduced to less than that required to complete the remaining activities, the PRPs should immediately notify EPA. Under conditions specified in the Order, PRPs are required to complete the RI/FS

irregardless of initial cost estimates or financial mechanisms.

- **Assistance for PRP Activities**

If PRPs propose to use consultants for conducting or assisting in the RI/FS, the PRPs should specify the tasks to be conducted by the consultants and submit personnel and corporate qualifications of the proposed firms to the EPA for review. Verification should be made that the PRPs' consultants have no conflict of interest with respect to the project. Any consultants having current EPA assignments as prime contractors or as subcontractors must obtain approval from their EPA Contract Officers before performing work for PRPs. Lack of clarification on possible conflicts of interest may delay the PRP RI/FS. EPA will reserve the right to review the PRPs' proposed selection of consultants and will disapprove their selection if, in EPA's opinion, they either do not possess adequate technical capabilities or there exists a conflict of interest. It should be noted that the responsibility for selection of consultants rests with the PRPs.

Attachment II

Initiation of PRP RI/FS Activities

Development of the Statement of Work

After the PRPs have been identified in the PRP Search Report they are sent either a general notice letter followed by a special notice letter or a general notice letter followed by an explanation pursuant to Section 122(a) why special notice procedures are not being used. EPA will engage in negotiations with those PRPs who have submitted a good faith offer in response to the notice letter and therefore have volunteered to perform the RI/FS. While the PRPs are demonstrating their capabilities for conducting the RI/FS, EPA will negotiate the terms of the Administrative Order. Either an acceptable Statement of Work or Work Plan must be incorporated by reference into the Agreement.

The Statement of Work (SOW) is typically developed by EPA and describes, in a comprehensive manner, all RI/FS activities to be performed, as reasonably anticipated, prior to the onset of the project. The SOW focuses on broad objectives and describes general activities that will be undertaken to achieve these objectives. Detailed procedures by which the work will be accomplished are not presented in the SOW, but are described in the subsequent Work Plan that is developed by the PRPs. In certain instances, with the approval of EPA, PRPs may prepare a single site plan incorporating the elements of an SOW and a Work Plan. In such instances, the site plan will be incorporated into the Order in place of the broader SOW.

- **Use of the EPA Model SOW**

EPA has developed a model SOW defining a comprehensive RI/FS effort which is contained in the RI/FS Guidance. Additionally, a model SOW for a PRP-lead RI/FS is being developed by OWPE and will be forthcoming. The Regions should develop a site-specific SOW based upon the model(s). RI/FS projects managed by PRPs will involve, at a minimum, all relevant activities set forth in the EPA model SOW. Further, all plans and reports identified as deliverables in the EPA model SOW must be identified as deliverables in the site-specific SOW and/or the Work Plan developed by the PRPs. Additional deliverables may be required by the

Regions and should be added to the Administrative Order.

- **Modification of the EPA Draft SOW Requirements**

The activities set forth in the model SOW are considered by EPA to be the critical RI/FS activities that are required by the NCP. PRPs should present detailed justifications for any proposed modifications and amendments to the activities set forth in the SOW. EPA will review all proposed modifications and approve or disapprove their inclusion in the SOW based on available information, EPA policy and guidance, overall program objectives, and the requirements of the NCP and CERCLA. EPA will not allow modifications that, in the judgment of the Agency, will lead to an unsatisfactory RI/FS or inconsistencies with the NCP.

Review of the RI/FS Project Plans

RI/FS project plans include those plans developed for the RI/FS. At a minimum the project plans should include a Work Plan, a Sampling and Analysis Plan, a Health and Safety Plan, and a Community Relations Plan. The Community Relations Plan is developed by EPA and should include a description of the PRPs' role in community relations activities, if any. EPA review and approval of the work plan and sampling and analysis plan will usually be required before PRPs can begin site activities. An example when limited project activities may be initiated prior to approval of the project plans would be if additional information is required to complete the Sampling and Analysis Plan. Additionally, conditional approvals to the Work Plan and Sampling and Analysis Plan may be provided in order to initiate field activities in a more timely manner. It should be noted that EPA does not "approve" the PRPs' Health and Safety Plan but rather, it is reviewed to ensure the protection of public health and the environment. The PRPs may be required to amend the plan if EPA determines that it does not adequately provide for such protection.

- **Contents of the Work Plan**

The Work Plan expands the tasks of the SOW, and the responsibilities specified in the Agreement, by presenting the rationale and methodology (including

detailed procedures) for conducting the RI/FS. Typically the Work Plan is developed after the draft Order and then incorporated into the Agreement. In some cases however, it may be appropriate for EPA to develop the Work Plan prior to actual negotiation with the PRPs and attach the plan to the draft Agreement. The PRP RI/FS Work Plan must be consistent with current EPA guidance. Guidance on developing acceptable Work Plans is available in the RI/FS Guidance. Additional guidance will be forthcoming in the proposed NCP. Once the Work Plan is approved by EPA, it becomes a public document and by the terms of the Agreement, should be incorporated by reference into that document. The Work Plan should, at a minimum, contain the following elements.

Introduction/Background Statement - PRPs should provide an introductory or background statement describing their understanding of the work to be performed at the site. This should include historical site information and should highlight present site conditions.

Objectives - A statement of what is to be accomplished and how the information will be utilized.

Scope - A detailed description of the work to be performed including a definition of work limits.

Management Plan - A description of the project management showing personnel with authority and responsibility for the appropriate aspects of the project and specific tasks to be performed. A single person should be identified as having overall responsibility for the project.

Work Schedule - A statement outlining the schedule for each of the required activities. This could be presented in the form of a Gantt or milestone chart. The schedule in the Work Plan must match that in the draft Order.

Deliverables - A description of the work products that will be submitted and their schedule for delivery. The schedule should include specific dates, if possible. Otherwise, the schedule should be in terms of the number of days/week after approval of the work plan.

- **Contents of the Sampling and Analysis Plan.**

A Sampling and Analysis Plan (SAP) must be submitted by the PRPs before initiation of relevant field activities. This plan contains two separate elements: a Field Sampling Plan and a Quality Assurance Project Plan. These documents were previously submitted as separate deliverables, but are now combined into one document. Though the SAP is typically implemented by PRP contractors, it is the

responsibility of the PRPs to ensure that the goals and standards of the plan are met. (Verification that the goals and standards of the SAP are met will also be part of EPA's oversight responsibilities.) The SAP should contain the following elements:

Field Sampling Plan - The Field Sampling Plan includes a detailed description of all RI/FS sampling and analytical activities that will be performed. These activities should be consistent with the NCP and relevant CERCLA guidance. Further guidance on developing Field Sampling Plans is presented in the RI/FS Guidance.

Quality Assurance Project Plan - The SAP must include a detailed description of quality assurance/quality control (QAQC) procedures to be employed during the RI/FS. This section is intended to ensure that the RI/FS is based on the correct level or extent of sampling and analysis required to produce sufficient data for evaluating remedial alternatives for a specific site. A second objective is to ensure the quality of the data collected during the RI/FS. Guidance on appropriate QAQC procedures may be found in the RI/FS Guidance as well as "Data Quality Objectives for the RI/FS Process" (March 1987 - OSWER Directive No. 9355.0-7B).

If the SAP modifies any procedures established in relevant guidance, it must provide an explanation and justification for the change.

- **Other Project Plans**

Other project plans that are likely to be required in the RI/FS process include the Health and Safety Plan and the Community Relations Plan.

Health and Safety Plan - PRPs should include a Health and Safety Plan either as part of the Work Plan or as a separate document. The Health and Safety Plan should address the measures taken by the PRPs to ensure that all activities will be conducted in an environmentally safe manner for the workers and the surrounding community. EPA reviews the Health and Safety Plan to ensure protection of public health and the environment. EPA does not, however, "approve" this plan. Guidance on the appropriate contents of a Health and Safety Plan may be found in the RI/FS Guidance. In addition, Health and Safety requirements are found in "OSHA Safety and Health Standards: Hazardous Waste Operations and Emergency Response" (40 CFR Part 1910.120).

Community Relations Plan - EPA must prepare a Community Relations Plan for each NPL site. The extent of PRP involvement in community relations activities should be detailed in this plan. Additional

information on Community Relations activities is contained below.

- Review and Approval

PRPs must submit all of the required RI/FS project plans (with the exception of the Community Relations Plan which is developed by EPA) to EPA for review, and in the case of the Work Plan and SAP, approval. EPA will review the plans for their technical validity and consistency with the NCP and relevant EPA guidance. Typically, the Agency must review and approve these plans before PRPs can begin any site activities. Any disagreements that arise between EPA and PRPs over the contents of the plans should be resolved according to the procedures set forth in the dispute resolution section of the relevant EPA/PRP Agreement.

Community Relations

EPA is responsible for developing and implementing an effective community relations program, regardless of whether RI/FS activities are Fund-financed or conducted by PRPs. At State-lead enforcement sites, funded by EPA under Superfund Memoranda of Agreement (see the "Draft Guidance on Preparation of a Superfund Memorandum of Agreement (October 5, 1987 - OSWER Directive No. 9375.0-01)), the State has the responsibility for development and implementation of a community relations program. PRPs may, under certain circumstances, assist EPA or the State in implementing the community relations activities. For example, PRPs may wish to participate in community meetings and in preparing fact sheets. PRP participation in community relations activities would, however, be at the discretion of the Regional Office, or the State, and would require oversight by the lead-agency. EPA will not under any circumstances negotiate press releases with PRPs.

EPA designs and implements community relations activities according to CERCLA and the NCP. A Community Relations Plan must be developed by EPA for all NPL sites as described by the EPA guidance, "Community Relations in Superfund: A Handbook" (U.S. EPA, 1988 - OSWER Directive No. 9230.0-03). The Community Relations Plan must be independent of negotiations with PRPs. Guidance for conducting community relations activities at Superfund enforcement sites is specifically addressed by Chapter VI of the Handbook and the EPA memo entitled "Community Relations Activities at Superfund Enforcement Sites--Interim Guidance" (November 1988 - OSWER Directive No. 9230.0-38). In some instances the decision regarding PRP participation in community relations activities will be made after the Community Relations Plan has been developed. As a result, the plan will need to be modified by EPA to reflect Agency and PRP roles and responsibilities.

EPA, or the State, will provide the Community Relations Plan to all interested parties at the same time. In general, if the case has not been referred to the Department of Justice (DOJ) for litigation, community relations activities during the RI/FS should be the same for Fund- and PRP-lead sites. If the case has been (or may potentially be) referred to DOJ for litigation, constraints will probably be placed on the scope of activities. The EPA Community Relations Plan may be modified after consultation with the technical enforcement staff, the Regional Counsel and other negotiation team members, including, if the case is referred, the lead DOJ or Assistant United States Attorneys (i.e., the litigation team). This technical and legal staff must be consulted prior to any public meetings or dissemination of fact sheets or other information; approval must be obtained prior to releases of information and discussions of technical information in advance. PRP participation in implementing community relations activities will be subject to EPA (or State) approval in administrative settlements and EPA/DOJ in civil actions. Key activities specific to community relations programs for enforcement sites include the following:

- Public Review of Work Plans for Administrative Orders

The PRP Work Plan, as approved by EPA, is incorporated into the Administrative Order (or Consent Decree). Once the Agreement is signed, it becomes a public document. Although there is no requirement for public comment on an Administrative Order, Regional staff are encouraged to announce, after the Order is final, that the PRP is conducting the RI/FS. Publication of notice and a corresponding 30-day comment period is required however, for Consent Decrees.

- Availability of RI/FS Information from the PRPs

PRPs, in agreeing to conduct the RI/FS, must also agree to provide all information necessary for EPA to implement a Community Relations Plan. The Agreement should identify the types of information that PRPs will provide, and contain conditions concerning the provision of this information. EPA should provide the PRPs with the content of the plan so that the PRPs can fully anticipate the type of information that will be made public. All information submitted by PRPs will be subject to public inspection (i.e., available through Freedom of Information Act requests, public dockets, or the administrative record) unless the information meets an exemption. An example would be if the information is deemed either as enforcement sensitive by EPA, or business confidential by EPA (based on the PRPs' representations), in conformance with 40 CFR Part 2.

Development of the ATSDR Health Assessment

Section 104(j)(6) of CERCLA requires the Agency for Toxic Substances and Disease Registry (ATSDR) to perform health assessments at all NPL facilities according to a specified schedule. The purpose of the health assessment is to assist in determining whether any current or potential threat to human health exists and to determine whether additional information on human exposure and associated health risks is needed.

The EPA remedial project manager (RPM) should coordinate with the appropriate ATSDR Regional representative for initiation of the health assessment. In general, the health assessment should be initiated at the start of the RI/FS. The ATSDR Regional representative will provide information on data needs specific to performing a health assessment to ensure that all necessary data will be collected during the RI. The RPM and the ATSDR Regional representative should also coordinate the transmission and review of pertinent documents dealing with the extent and nature of site contamination (i.e., applicable technical memoranda and the draft RI). As ATSDR has no provisions for withholding documents, if requested by the public, the RPM must discuss enforcement sensitive documents and drafts with the ATSDR Regional representative rather than providing copies to them. This will ensure EPA's enforcement confidentiality. Further guidance on coordination of RI/FS activities with ATSDR can be found in the document entitled "Guidance for Coordinating ATSDR Health Assessment Activities with the Superfund Remedial Process" (March 1987 - OSWER Directive No. 9285.4-02).

Identification of Oversight Activities

EPA will review RI/FS plans and reports as well as provide field oversight of PRP activities during the RI/FS. To ensure that adequate resources are committed and that appropriate activities are

performed, EPA should develop an oversight plan that defines the oversight activities that must be performed including EPA responsibilities, RI/FS products to be reviewed, and site activities that EPA will oversee. In planning for oversight, EPA should consider such factors as who will be performing oversight and the schedule of activities that will be monitored. A tracking system for recording PRP milestones should be developed. This system should also track activities performed by oversight personnel and other appropriate cost items such as travel expenses.

Identification and Procurement of EPA Assistance

In accordance with Section 104(a)(1) EPA must arrange for a qualified party to assist in oversight of the RI/FS. The following section provides guidance for identifying and procuring such assistance for EPA activities.

- **Assistance for EPA Activities**

As specified in Section 104(a)(1), EPA is required to contract with or arrange for a qualified person to assist in oversight of the RI/FS. Qualified individuals are those groups with the professional qualifications, expertise, and experience necessary to provide assurance that the Agency is conducting appropriate oversight of PRP RI/FS activities.

Normally, EPA will obtain oversight assistance either through the Technical Enforcement Support (TES) contract, the Alternative Remedial Contracts Strategy Contract (ARCS), or occasionally through the Remedial Action (REM) contracts. In some cases oversight assistance may be provided by States through the use of Cooperative Agreements. Oversight assistance may also be obtained through the U.S. Army Corps of Engineers or other governmental agencies; interagency Agreements should be utilized to obtain such assistance.

Attachment III

Review and Oversight of the RI/FS

Review of Plans, Reports, and Records

EPA will review all RI/FS products which are submitted to the Agency as specified in the Work Plan or Administrative Order. PRPs should ensure that all plans, reports, and records are comprehensive, accurate, and consistent in content and format with the NCP and relevant EPA guidance. After this review process, EPA will either approve or disapprove the product. If the product is found to be unsatisfactory, EPA will notify the PRPs of the discrepancies or deficiencies and will require corrections within a specified time period.

- **Project Plans**

EPA will review all project plans that are submitted as deliverables in fulfillment of the Agreement. These plans include the Work Plan, the Sampling and Analysis Plan (including both the Field Sampling Plan and the Quality Assurance Project Plan), and the Health and Safety Plan. If the initial submittals are not sufficient in content or scope, the RPM will request that the PRPs submit revised document(s) for review. EPA does not "approve" the PRP's Health and Safety Plan but rather, it is reviewed to ensure the protection of public health and the environment. The PRP's Work Plan and Sampling and Analysis Plan, on the other hand, must be reviewed and approved prior to the initiation of field activities. Conditional approval to these plans may be provided in order to initiate field activities in a more timely manner.

The PRPs may be required to develop additional Work Plans or modify the initial Work Plan contained in or created pursuant to the Agreement. These changes may result from the need to: (1) re-evaluate the RI/FS activities due either to changes in or unexpected site conditions; (2) expand the initial Work Plan when additional detail is necessary; or (3) modify or add products to the Work Plan based on new information (e.g., a new population at risk). EPA will review and approve all Work Plans and/or modifications to Work Plans once they are submitted for review.

- **Reports**

PRPs will, at a minimum, submit monthly progress reports, technical memorandums or reports, and the draft and final RI/FS reports as required in the Agreement. To assist in the development of the RI/FS and review of documents, additional deliverables may be specified by the Region and included in the Agreement. These reports and deliverables will be reviewed by EPA to ensure that the activities specified in the Order and approved Work Plan are being properly implemented. These reports will generally be submitted according to the conditions and schedule set forth in the Agreement. Elements of the PRP reports are discussed below.

Monthly Progress Reports - The review of monthly progress reports is an important activity performed during oversight. These reports should provide sufficient detail to allow EPA to evaluate the past and projected progress of the RI/FS. PRPs should submit these written progress reports to the RPM. The report should describe the actions and decisions taken during the previous month and activities scheduled during the upcoming reporting period. In addition, technical data generated during the month (i.e., analytical results) should be appended to the report. Progress reports should also include a detailed statement of the manner and extent to which the procedures and dates set forth in the Agreement/Work Plan are being met. Generally, EPA will determine the adequacy of the performance of the RI/FS by reviewing the following subjects discussed in progress reports:

- **Technical Summary of Work**

The monthly report will describe the activities and accomplishments performed to date. This will generally include a description of all field work completed, such as sampling events and installation of wells; a discussion of analytical results received; a discussion of data review activities; and a discussion of the development, screening, and detailed analysis of alternatives. The report will also describe the activities to be performed during the upcoming month.

- **Schedule**

EPA will oversee PRP compliance with respect to those schedules specified in the Order. Delays, with the exception of those specified under the Force Majeure clause of the Agreement, may result in penalties, if warranted. The RPM should be immediately notified if PRPs cannot perform required activities or cannot provide the required deliverables in accordance with the schedule specified in the Work Plan. In addition, PRPs should notify the RPM when circumstances may delay the completion of any phase of the work or when circumstances may delay access to the site. PRPs should also provide to the RPM, in writing, the reasons for, and the anticipated duration of, such delays. Any measures taken or to be taken by the PRPs to prevent or minimize the delay should be described including the timetables for implementing such measures.

- **Budget**

The relationship of budgets to expenditures should be tracked where the RI/FS is funded with a financial mechanism established by the PRPs. If site activities require more funds than originally estimated, EPA must be assured that the PRPs are financially able to undertake additional expenditures. While EPA does not have the authority to review or approve a PRP budget, evaluating costs during the course of the RI/FS allows EPA to effectively monitor activity to ensure timely completion of RI/FS activities. If the PRPs run over budget, EPA must be assured that they can continue the RI/FS activities as scheduled. Therefore, if specified in the Agreement, PRPs should submit budget expenditures and cost overrun information to EPA. Budget reports need not present dollar amounts, but should indicate the relationship between remaining available funds and the estimate of the costs of remaining activities.

Problems

Any problems that the PRPs encounter which could affect the satisfactory performance of the RI/FS should be brought to the immediate attention of EPA. Such problems may or may not be a force majeure event, or caused by a force majeure event. EPA will review problems and advise the PRPs accordingly. Problems which may arise include, but are not limited to:

- Delays in mobilization or access to necessary equipment;
- Unanticipated laboratory/analytical time requirements;

- Unsatisfactory QA/QC performance;

- Requirements for additional or more complex sampling;
- Prolonged unsatisfactory weather conditions;
- Unanticipated site conditions; and
- Unexpected, complex community relations activities.

Other Reports - All other reports, such as technical reports and draft and final RI/FS reports, should be submitted to EPA according to the schedule contained in the Order or the approved Work Plan. EPA will review and approve these reports as they are submitted. Suggested formats for the RI/FS reports are presented in the RI/FS Guidance.

- **Records**

PRPs should preserve all records, documents, and information of any kind relating to the performance of work at the site for a minimum of 6 years after completion of the work and termination of the Administrative Order. After the 6-year period, the PRPs should offer the records to EPA before their destruction.

Document control should be a key element of all recordkeeping. The following activities require careful recordkeeping and will be subject to EPA oversight:

Administration - PRP administrative activities should be accurately documented and recorded. Necessary precautions to prevent errors or the loss or misinterpretation of data should be taken. At a minimum, the following administrative actions should be documented and recorded:

- Contractor work plans, contracts, and change orders;
- Personnel changes;
- Communications between and among PRPs, the State, and EPA officials regarding technical aspects of the RI/FS;
- Permit application and award (if applicable); and
- Cost overruns.

Technical Analysis - Samples and data should be handled according to procedures set forth in the Sampling and Analysis Plan. Documentation

establishing adherence to these procedures should include:

- Sample labels;
- Shipping forms;
- Chain-of-custody forms; and
- Field log books.

All analytical data in the RI/FS process should be managed as set forth in the Sampling and Analysis Plan. Such analytical data may be the product of:

- Contractor laboratories;
- Environmental and public health studies; and
- Reliability, performance, and implementability studies of remedial alternatives.

Decision Making - Actions or communications among PRPs that involve decisions affecting technical aspects of the RI/FS should be documented. Such actions and communications include those of the project manager (or other PRP management entity), steering committees, or contractors.

• Administrative Record Requirements

Section 113(k) of CERCLA requires that the Agency establish an administrative record upon which the selection of a response action is based. A suggested list of documents which are most likely to be included in any adequate administrative record is provided in the memorandum entitled "Draft Interim Guidance on Administrative Records for Selection of CERCLA Response Actions" (June 23, 1988 - OSWER Directive No. 9833.3A). More detailed guidance will be forthcoming, including guidance provided in the revisions to the NCP. There are, however, certain details associated with compiling and maintaining an administrative record that are unique to PRP RI/FS activities.

EPA is responsible for compiling and maintaining the administrative record, and generating and updating an index. If EPA and the PRPs mutually agree, the PRPs may be allowed to house and maintain the administrative record file at or near the site; they may not, however, be responsible for the actual compilation of the record. Housing and maintaining the administrative record would include setting up a publicly accessible area at or near the site and ensuring that documents remain and are updated as necessary. EPA must always be responsible for deciding whether documents are included in the

administrative record; transmitting records to the PRPs; and maintaining the index to the repository.

The information which may comprise the administrative record must be available to the public from the time an RI/FS Work Plan is approved by EPA. Once the Work Plan has been approved the PRPs must transmit to EPA, at reasonable, regular intervals, all of the information that is generated during the RI/FS that is related to selection of the remedy. The required documentation should be specified in the Administrative Order. The Agreement should also specify those documents generated prior to the RI/FS that must be obtained from the PRPs for inclusion in the record file. This may include any previous studies conducted under State or local authorities, management documents held by the PRPs such as hazardous waste shipping manifests, and other information about site characteristics or conditions not contained in any of the above documents.

Field Activities

• Field Inspections

Field inspections are an important oversight mechanism for determining the adequacy of the work performed. EPA will therefore conduct field inspections as part of its oversight responsibilities. The oversight inspections should be performed in a way that minimizes interference with PRP site activities or undue complication of field activities. EPA will take corrective steps, as described in Section VII and Attachment IV of this appendix, if unsatisfactory performance or other deficiencies are identified.

Several field-related tasks may be performed during oversight inspections. These tasks include:

On-site presence/inspection - As specified in Section 104(e)(3), EPA reserves the right to conduct on-site inspections at any reasonable time. EPA will therefore establish an on-site presence to assure itself of the quality of work being conducted by PRPs. At a minimum, field oversight will be conducted during critical times, such as the installation of monitoring wells and during sampling events. EPA will focus on whether the PRPs adhere to procedures specified in the SOW and Work Plan(s), especially those concerning QA/QC procedures. Further guidance regarding site characterization activities is presented in the RI/FS Guidance, the "Compendium of Superfund Field Operations Methods" (August 1987 - OSWER Directive No. 9355.0-1 41), the "RCRA Ground Water Technical Enforcement Guidance Document" (September 1986 - OSWER Directive No. 9950.1) the NEIC Manual for *Groundwater/ Subsurface Investigations at Hazardous Waste*

Sites (U.S. EPA, 1981c), and OWPE's forthcoming "Guidance on Oversight of Potentially Responsible Party Remedial Investigations and Feasibility Studies."

Collection and analysis of samples - EPA may collect a number of QA/QC samples including blank, duplicate, and split samples. The results of these sample analyses will be compared to the results of PRP analyses. This comparison will enable EPA to identify potential quality control problems and therefore help to evaluate the quality of the PRP investigation.

Environmental Monitoring - EPA may supplement any PRP environmental monitoring activity. Such supplemental monitoring may include air or water studies to determine additional migration of sudden releases that may have occurred as a result of site activities.

- **QA/QC Audits**

EPA may either conduct, or require the PRPs to conduct (if specified in the Agreement), laboratory audits to ensure compliance with proper QA/QC and analytical procedures, as specified in the Sampling and Analysis Plan. These audits will involve on-site inspections of laboratories used by PRPs and analyses of selected QA/QC samples. All procedures must be in accordance with those outlined in *The User's Guide to the Contract Laboratory Program*, (U.S. EPA, 1986) or otherwise specified in the Sampling and Analysis Plan.

- **Chain-of-Custody**

Chain-of-custody procedures will be evaluated by EPA. This evaluation will focus on determining if the PRPs and their contractors adhere to the procedures set forth in the Sampling and Analysis Plan. Proper chain-of-custody procedures are described in the *National Enforcement Investigation Center (NEIC) Policies and Procedures Manual*, (U.S. EPA, 1981 b). Evaluation of chain-of-custody procedures will occur during laboratory audits as well as during on-site inspections of sampling activities.

Meetings

Meetings between EPA, the State, and PRPs should be held on a regular basis (as specified in the Agreement) and at critical times during the RI/FS. Such critical times may at a minimum include when the SOW and the Work Plan are reviewed, the RI is in progress and completed, remedial alternatives are developed and screened, detailed analysis of the

alternatives is performed, and the draft and final RI/FS reports are submitted. These meetings will discuss overall progress, discrepancies in the work performed, problems encountered in the performance of RI/FS activities and their resolution, community relations, and other related issues and concerns. While meetings may be initiated by either the PRPs or EPA at any time, they will generally be conducted at the stages of the RI/FS listed below.

- **Initiation of Activities**

EPA, the State, and the PRPs may meet at various times before field activities begin to discuss the initial planning of the RI/FS. Meetings may be arranged to discuss, review, and approve the SOW; to develop the EPA/PRP Agreement; and to develop, review, and approve the Work Plan.

- **Progress**

EPA may request meetings to discuss the progress of the RI/FS. These meetings should be held at least quarterly and will focus on the items submitted in the monthly progress reports and the findings from EPA oversight activities. Any problems or deficiencies in the work will be identified and corrective measures will be requested (see Section VIII and Attachment IV of this appendix).

- **Closeout**

EPA may request a closeout meeting upon completion of the RI/FS. This meeting will focus on the review and approval of the final RI/FS report, termination of the RI/FS Agreement, and any final on-site activities which the PRPs may be required to perform. These activities may include maintaining the site and ensuring that fences and warning signs are properly installed. The transition to remedial design and remedial action will also be discussed during this meeting.

Special Studies

EPA may determine that special studies related to the PRP RI/FS are required. These studies can be conducted to verify the progress and results of RI/FS activities or to address a specific complex or controversial issue. Normally, special studies are performed by the PRPs; however, there may be cases in which EPA will want to conduct the independent studies. The PRPs should be informed of any such studies and given adequate time to provide necessary coordination of site personnel and resources. If not provided for in the Agreement, modifications to the Work Plan may be required.

Attachment IV

Control of Activities

Identification of Deficiencies

Oversight activities may identify unsatisfactory or deficient PRP performance. The determination of such performance may be based upon findings such as:

- Work products are inconsistent with the SOW or Work Plan;
- Technical deficiencies exist in submittals or other RI/FS products;
- Unreasonable delays occur while performing RI/FS activities; and
- Procedures are inconsistent with the NCP.

Corrective Measures

The need to perform corrective measures may arise in the event of deficiencies in reports or other work products, or unsatisfactory performance of field or laboratory activities. When deficiencies are identified corrective measures may be sought by: (1) notifying the PRPs; (2) describing the nature of the deficiency; and (3) either requesting the PRPs to take whatever actions they regard as appropriate or setting forth appropriate corrective measures. The following subsections describe this process for each of the two general types of activities that may require corrective measures.

• Corrective Measures Regarding Work Products

Agency review and approval procedures for work products generally allow three types of responses: (1) approval; (2) approval with modifications; and (3) non-approval. Non-approval of a work product (including project plans) immediately constitutes a notice of deficiency. EPA will immediately notify the PRPs if any work product is not approved and will explain the reason for such a finding.

Approval with modifications will not lead to a notice of deficiency if the modifications are made by the PRPs without delay. If the PRPs significantly delay in

responding to the modifications, the RPM would issue a notice of deficiency to the PRP project manager detailing the following elements:

- A description of the deficiency or a statement describing in what manner the work product was found to be deficient or unsatisfactory;
 - Modifications that the PRPs should make in the work product to obtain approval;
 - A request that the PRPs prepare a plan, if necessary, or otherwise identify actions that will lead to an acceptable work product;
 - A schedule for submission of the corrected work product;
 - An invitation to the PRPs to discuss the matter in a conference; and
 - A statement of the possibility of EPA takeover at the PRPs' expense, EPA enforcement, or penalties (as appropriate).
- Corrective Measures Regarding Field Activities

When the lead agency discovers that the PRPs (or their contractors) are performing the RI/FS field work in a manner that is inconsistent with the Work Plan, the PRPs should be notified of the finding and asked to voluntarily take appropriate corrective measures. The request is generally made at a progress meeting, or, if immediate action is required, at a special meeting held specifically to discuss the problem. If corrective measures are not voluntarily taken, the RPM should, in conjunction with appropriate Regional Counsel, issue a notice of deficiency containing the following elements:

- A description of the deficiency;
- A request for an explanation of the failure to perform satisfactorily and a plan for addressing the necessary corrective measures;

- A statement that failure to present an explanation may be taken as an admission that there is no valid explanation;
- An invitation to discuss the matter in a conference (where appropriate);
- A statement that stipulates penalties may accrue or are accruing, project termination may occur, and/or civil action may be initiated if appropriate actions are not taken to correct the deficiency; and
- A description of the potential liabilities incurred in the event that appropriate actions are not taken.

Modifications to the Work Plan/Additional Work

Under the Administrative Order (or Consent Decree), PRPs agree to complete the RI/FS, including the tasks required under either the original Work Plan or a subsequent or modified Work Plan. This may include determinations and evaluations of conditions that are unknown at the time of execution of the Agreement. Modifications to the original RI/FS Work Plan are frequently required as field work progresses. Work not explicitly covered in the Work Plan is often required and therefore provided for in the Order. This work is usually identified during the RI and is driven by the need for further information in a specific area. In general, the Agreement should provide for fine-tuning of the RI, or the investigation of an area previously unidentified. As it becomes clear what additional work is necessary, EPA will notify the PRPs of the work to be performed and determine a schedule for completion of the work.

EPA must ensure that clauses for modifications to the Work Plan are included in the Agreement so that the PRPs will carry out the modifications as the need for them is identified. To facilitate negotiation on these points, EPA may consider one or more of the following provisions in the Agreement for addressing such situations:

- Defining the limits of additional work requirements;
- Specifying the dispute resolution process for modified Work Plans and additional work requirements;
- Defining the applicability of stipulated penalties to any additional work which the PRPs agree to undertake.

Dispute Resolution

As discussed elsewhere in this guidance, the RI/FS Order developed between EPA and the PRPs sets

forth the terms and conditions for conducting the RI/FS. An element of this Agreement is a statement of the specific steps to be taken if a dispute arises between EPA (or its representatives) and the PRPs. These steps should be well defined and agreed upon by all signatories to the Agreement.

A dispute with respect to the Order is followed by a specific period of discussion with the PRPs. After the discussion period, EPA issues a final decision which becomes incorporated into the Agreement. Administrative Orders should clarify that with respect to all submittals and work performed, EPA will be the final arbiter. The court, on the other hand, is the final arbiter for Consent Decrees.

Penalties

As an incentive for PRPs to properly conduct the RI/FS and correct any deficiencies discovered during the conduct of the Agreement, EPA should include stipulated penalties. Section 121 provides up to \$25,000 per day in stipulated penalties for violations of a Consent Decree while Section 122 allows EPA to seek or impose civil penalties for violations of Administrative Orders.³ Penalties should begin to accrue on the first day of the deficiency and continue to be assessed until the deficiency is corrected. The type of violation (i.e., reporting requirements vs. implementation of construction requirements), as well as the amounts, should be specified as stipulated penalties in the Agreement to avoid negotiations on this point which may delay the correction. The amounts should be set pursuant to the criteria of Section 109 and as such must take into account the nature, circumstances, extent, and gravity of the violations as well as the PRPs' ability to pay, prior history of violations, degree of culpability, and the economic benefit resulting from noncompliance. Additional information on stipulated penalties can be found in OECM's "Guidance on the Use of Stipulated Penalties in Hazardous Waste Consent Decrees" (September 27, 1987).

Project Takeover

Generally, EPA will consult with PRPs to discuss deficiencies and corrective measures. If these discussions fail, EPA has two options: (1) pursue legal action to force the PRPs to continue the work; or (2) take over the RI/FS. If taking legal action will not significantly delay implementation of necessary remedial or removal actions, EPA may commence civil action against the noncomplying PRP to enforce the Administrative Order. Under a Consent Decree, the matter would be presented to the court in which

³In order to provide for stipulated penalties in an Administrative Order the parties must voluntarily include them in the terms of the Agreement.

the Decree was filed to enforce the provisions of the Decree.

If a delay in RI/FS activities endangers public health and/or the environment or will significantly delay implementation of necessary remedial actions, EPA should move to replace the PRP activities with Fund-financed actions. The RPM will take the appropriate steps to assume responsibility for the

RI/FS, including issuing a stop-work order to the PRPs and notifying the EPA remedial contractors. In issuing stop work orders, RPMs should be aware that Fund resources may not be automatically available. But, in the case of PRP actions which threaten human health or the environment, there may be no other course of action. Once this stop work order is issued, a fund-financed RI/FS will be undertaken consistent with EPA funding procedures.

Appendix B

Elements of RI/FS Project Plans

I. Elements of a Work Plan¹

Introduction - A general explanation of the reasons for the RI/FS and the expected results or goals of the RI/FS process are presented.

Site Background and Physical Setting - The current understanding of the physical setting of the site, the site history, and the existing information on the condition of the site are described. (See Section 2.2.2.1.)

Initial Evaluation - The conceptual site model developed during scoping is presented, describing the potential migration and exposure pathways and the preliminary assessment of human health and environmental impacts. (See Section 2.2.2.2).

Work Plan Rationale - Data requirements for both the risk assessment and the alternatives evaluation identified during the formulation of the DQOs are documented, and the work plan approach is presented to illustrate how the activities will satisfy data needs.

RI/FS Tasks - The tasks to be performed during the RI/FS are presented. This description incorporates RI site characterization tasks identified in the QAPP and the FSP, the data evaluation methods identified during scoping (see Section 2.2.9), and the preliminary determination of tasks to be conducted after site characterization (see Section 2.2.7 of this guidance).

II. Standard Federal-Lead RI/FS Work Plan Tasks

Task 1. Project Planning (Project Scoping)

This task includes efforts related to initiating a project after the SOW is issued. The project planning task is defined as complete when the work plan and supplemental plans are approved (in whole or in part). The following typical elements are included in this task:

¹These elements are required in a work plan but do not necessarily represent the organization of a work plan.

- Work plan memorandum
- Kickoff meeting (RI/FS brainstorming meeting)
- Site visit/meeting
- Obtaining easements/permits/site access
- Site reconnaissance and limited field investigation
- Site survey²/topographic map/review of existing aerial photographs
- Collection and evaluation of existing data
- Development of conceptual site model
- Identification of data needs and DQOs
- Identification of preliminary remedial action objectives and potential remedial alternatives
- Identification of treatability studies that may be necessary
- Preliminary identification of ARARs
- Preparation of plans (e.g., work plan, health and safety plan, QAPP, FSP)
- Initiation of subcontract procurement
- Initiation of coordination with analytical laboratories (CLP and non-CLP)
- Task management and quality control

Task 2. Community Relations

This task incorporates all efforts related to the preparation and implementation of the community relations plan for the site and is initiated during the scoping process. It includes time expended by both technical and community relations personnel. This task ends when community relations work under Task

²A site survey may be conducted during project planning or may occur during the field investigation task but should not occur in both.

12 is completed, but the task does not include work on the responsiveness summary in the ROD (see Task 12). The following are typical elements included in this task:

- Conducting community interviews
- Preparing a community relations plan
- Preparing fact sheets
- Providing public meeting support
- Providing technical support for community relations
- Implementing community relations
- Managing tasks and conducting quality control

Task 3. Field Investigation

This task involves efforts related to fieldwork in conducting the RI. It includes the procurement of subcontractors related to field efforts. The task begins when any element, as outlined in the work plan, is approved (in whole or in part) and fieldwork is authorized.³ Field investigation is defined as complete when the contractor and subcontractors are demobilized from the field. The following activities are typically included in this task:

- Procurement of subcontracts
- Mobilization
- Media sampling
- Source testing
- Geology/hydrogeological investigations
- Geophysics
- Site survey/topographic mapping (if not performed in project planning task)
- Field screening/analyses
- Procurement of subcontractors
- RI waste disposal
- Task management and quality control

Task 4. Sample Analysis/ Validation

This task includes efforts relating to the analysis and validation of samples after they leave the field. Separate monitoring of close support laboratories may be required. Any efforts associated with laboratory procurement are also included in this task. The task

³Note that limited fieldwork during project scoping may be authorized as part of the work assignment to prepare the RI/FS work plan.

ends on the date that data validation is complete. The following typical activities are usually included in this task:

- Sample management
- Non-CLP analyses
- Use of mobile laboratories
- Data validation
- Testing of physical parameters
- Task management and quality control

Task 5. Data Evaluation

This task includes efforts related to the analysis of data once it has been verified that the data are of acceptable accuracy and precision. The task begins on the date that the first set of validated data is received by the contractor project team and ends during preparation of the RI report when it is deemed that no additional data are required. The following are typical activities:

- Data evaluation
- Data reduction and tabulation
- Environmental fate and transport modeling/evaluation
- Task management and quality control

Task 6. Assessment of Risks

This task includes efforts related to conducting the baseline risk assessment. The task will include work to assess the potential human health and environmental risks associated with the site. Work will begin during the RI and is completed once the baseline risk assessment is completed.⁴ The following are typical activities:

- Identification of contaminants of concern (or indicator chemicals)
- Exposure assessment (including any modeling performed specifically for this function)
- Toxicity assessment
- Risk characterization
- Task management and quality control

⁴Limited efforts to assess potential human health and environmental risks are, to some extent, initiated during scoping when the conceptual site model is being developed.

Task 7. Treatability Study/Pilot Testing

This task includes efforts to prepare and conduct pilot, bench, and treatability studies. This task begins with the development of work plans for conducting the tests and is complete once the report has been completed. The following are typical activities:

- Work plan preparation or work plan amendment
- Test facility and equipment procurement
- Vendor and analytical service procurement
- Equipment operation and testing
- Sample analysis and validation
- Evaluation of results
- Report preparation
- Task management and quality control

Task 8. Remedial Investigation Reports

This task covers all efforts related to the preparation of the findings once the data have been evaluated under Tasks 5 and 6. The task covers all draft and final RI reports as well as task management and quality control. The task ends when the last RI document is submitted by the contractor to EPA. The following are typical activities:

- Preparation of a preliminary site characterization summary (see Section 3.7.2 of this guidance)
- Data presentation (formatting tables, preparing graphics)
- Writing the report
- Reviewing and providing QC efforts
- Printing and distributing the report
- Holding review meetings
- Revising the report on the basis of agency comments
- Providing task management and control

Task 9. Remedial Alternatives Development/Screening

This task includes efforts to select the alternatives to undergo full evaluation. The task is initiated once sufficient data are available to develop general

response actions and begin the initial evaluation of potential technologies. This task is defined as complete when a final set of alternatives is chosen for detailed evaluation. The following are typical activities:

- Identifying/screening potential technologies
- Assembling potential alternatives
- Identifying action-specific ARARs
- Evaluating each alternative on the basis of screening criteria (effectiveness, implementability, cost)
- Reviewing and providing QC of work effort
- Preparing the report or technical memorandum
- Holding review meetings
- Refining the list of alternatives to be evaluated

Task 10. Detailed Analysis of Remedial Alternatives

This task applies to the detailed analysis and comparison of alternatives. The evaluation activities include performing detailed human health, environmental, and institutional analyses. The task begins when the alternatives to undergo detailed analysis have been identified and agreed upon and ends when the analysis is complete. The following are typical activities:^a

- Refinement of alternatives
- Individual analysis against the criteria
- Comparative analysis of alternatives against the criteria
- Review of QC efforts
- Review meetings
- Task management and QC

Task 11. Feasibility Study (or RI/FS) Reports

Similar to the RI reports task, this task is used to report FS deliverables. However, this task should be used in lieu of the RI reports task to report costs and schedules for combined RI/FS deliverables. The task ends when the FS (or RI/FS) is released to the public. The following are typical activities:

^aState and community acceptance will be evaluated by the lead agency during remedy selection.

- Presenting data (formatting tables, preparing graphics)
- Writing the report
- Printing and distributing the report
- Holding review meetings
- Revising the report on the basis of agency comments
- Providing task management and quality control

Task 12. Post RI/FS Support

This task includes efforts to prepare the proposed plan, the responsiveness summary, support the ROD, conduct any predesign activities, and close out the work assignment. All activities occurring after the release of the FS to the public should be reported under this task. The following are typical activities:

- Preparing the predesign report
- Preparing the conceptual design
- Attending public meetings
- Writing and reviewing the responsiveness summary
- Supporting ROD preparation and briefings
- Reviewing and providing QC of the work effort
- Providing task management and QC

Task 13. Enforcement Support

This task includes efforts during the RI/FS associated with enforcement aspects of the project. Activities vary but are to be associated with efforts related to PRPs. The following are typical activities:

- Reviewing PRP documents
- Attending negotiation meetings
- Preparing briefing materials
- Assisting in the preparation of ROD
- Providing task management and QC

Task 14. Miscellaneous Support

This task is used to report on work that is associated with the project but is outside the normal RI/FS scope of work. Activities will vary but include the following:

- Specific support for coordination with and review of ATSDR activities and reports
- Support for review of special State or local projects

The following are some specific comments applicable to the 14 tasks described above:

- All standard tasks or all work activities under each task need not be used for every RI/FS. Only those that are relevant to a given project should be used.
- Tasks include both draft and final versions of deliverables unless otherwise noted.
- The phases of a task should be reported in the same task (e.g., field investigation Phase I and Phase II will appear as one field investigation task).
- If an RI/FS is divided into distinct operable units, each operable unit should be monitored and reported on separately. Therefore, an RI/FS with several operable units may, in fact, have more than 15 tasks, although each of the tasks will be one of the 15 standard tasks.
- Costs associated with project management and technical QA are included in each task.
- Costs associated with procuring subcontractors are included in the task in which the subcontractor will perform work (not the project planning task).
- Lists of standard tasks define the minimum level of reporting. For federal-lead tasks, some RPMs and contractors currently report progress in a more detailed fashion and may continue to do so as long as activities are associated with standard tasks.

III. Elements of a Quality Assurance Project Plan

Title Page - At the bottom of the title page, provisions should be made for the signatures of approving personnel. As a minimum, the QAPP must be approved by the following:

- Subcontractor's project manager (if a subcontractor is used)
- Subcontractor's QA manager (if a subcontractor is used)
- Contractor's project manager (if applicable)

- Contractor's QA manager (if applicable)
- Lead agency's project officer
- Lead agency's QA officer (if applicable)

Provision should be made for the approval or review of others (e.g., regional laboratory directors), if applicable.

Table of Contents - The table of contents will include an introduction, a serial listing of the 16 QAPP elements, and a listing of any appendixes that are required to augment the QAPP. The end of the table of contents should include a list of the recipients of official copies of the QAPP.

Project Description - The introduction to the project description consists of a general paragraph identifying the phase of the work and the general objectives of the investigation. A description of the location, size, and important physical features of the site such as ponds, lagoons, streams, and roads should be included (a figure showing the site location and layout is helpful). A chronological site history including descriptions of the use of the site, complaints by neighbors, permitting, and use of chemicals needs to be provided along with a brief summary of previous sampling efforts and an overview of the results. Finally, specific project objectives for this phase of data gathering need to be listed, and ways in which the data will be used to address each of the objectives must be identified. **Those items above that are also included in the work plan need not be repeated in the QAPP and, instead, may be incorporated by reference.**

Project Organization and Responsibilities - This element identifies key personnel or organizations that are necessary for each activity during the study. A table or chart showing the organization and line of authority should be included. When specific personnel cannot be identified, the organization with the responsibility should be listed.

QA Objectives for Measurement - For individual matrix groups and parameters, a cooperative effort should be undertaken by the lead agency, the principal engineering firm, and the laboratory staff to define what levels of quality should be required for the data. These QA objectives will be based on a common understanding of the intended use of the data, available laboratory procedures, and available resources. The field blanks and duplicate field sample aliquots to be collected for QA purposes should be itemized for the matrix groups identified in the project description.

The selection of analytical methods requires a familiarity with regulatory or legal requirements concerning data usage. Any regulations that mandate

the use of certain methods for any of the sample matrices and parameters listed in the project description should be specified.

The detection limits needed for the project should be reviewed against the detection limits of the laboratory used. Special attention should be paid to the detection limits provided by the laboratory for volatile organic compounds, because these limits are sometimes insufficient for the analysis of drinking water. Detection limits may also be insufficient to assess attainment of ARARs. For Federal-lead projects, if QA objectives are not met by CLP RASSs, then one or more CLP SASs can be written.

Quantitative limits should be established for the following QA objectives:

1. Accuracy of spikes, reference compounds
2. Precision
3. Method detection limits

These limits may be specified by referencing the SOW for CLP analysis, including SAS requests, in an appendix and referring to the appendix or owner/operator manuals for field equipment.

Completeness, representativeness, and comparability are quality characteristics that should be considered during study planning. Laboratories should provide data that meet QC acceptance criteria for 90 percent or more of the requested determinations. Any sample types, such as control or background locations, that require a higher degree of completeness should be identified. "Representativeness" of the data is most often thought of in terms of the collection of representative samples or the selection of representative sample aliquots during laboratory analysis. "Comparability" is a consideration for planning to avoid having to use data gathered by different organizations or among different analytical methods that cannot reasonably be compared because of differences in sampling conditions, sampling procedures, etc.

Sampling Procedures - These procedures append the site-specific sampling plan. Either the sampling plan or the analytical procedures element may document field measurements or test procedures for hydrogeological investigations.

For each major measurement, including pollutant measurement systems, a description of the sampling procedures to be used should be provided. Where applicable, the following should be included:

- A description of techniques or guidelines used to select sampling sites

- A description of the specific sampling procedures to be used
- Charts, flow diagrams, or tables delineating sampling program
- A description of containers, procedures, reagents, and so forth, used for sample collection, preservation, transport, and storage
- A discussion of special conditions for the preparation of sampling equipment and containers to avoid sample contamination
- A description of sample preservation methods
- A discussion of the time considerations for shipping samples promptly to the laboratory
- Examples of the custody or chain-of-custody procedures and forms
- A description of the forms, notebooks, and procedures to be used to record sample history, sampling conditions, and analyses to be performed

The DQO document described above can also be incorporated by reference in this section. In addition, the *Compendium of Superfund Field Operations Methods* (U.S. EPA, September 1987) contains information pertinent to this section and can be incorporated by reference.

Sample Custody - Sample custody is a part of any good laboratory or field operation. If samples were needed for legal purposes, chain-of-custody procedures, as defined by the *NEIC Policies and Procedures* (U.S. EPA, June 1985), would be used. Custody is divided into three parts:

- Sample collection
- Laboratory
- Final evidence files

The QAPP should address all three areas of custody and should refer to the *User's Guide to the Contract Laboratory Program* (U.S. EPA, December 1986) and Regional guidance documents for examples and instructions. For federal-lead projects, laboratory custody is described in the CLP SOW; this may be referenced. Final evidence files include all originals of laboratory reports and are maintained under documented control in a secure area.

A sample or an evidence file is under custody if:

- It is in your possession.

- It is in your view, after being in your possession.
- It was in your possession and you placed it in a secure area.
- It is in a designated secure area.

A QAPP should provide examples of chain-of-custody records or forms used to record the chain of custody for samples, laboratories, and evidence files.

Calibration Procedures - These procedures should be identified for each parameter measured and should include field and laboratory testing. The appropriate standard operating procedures (SOPs) should be referenced, or a written description of the calibration procedures to be used should be provided.

Analytical Procedures - For each measurement, either the applicable SOP should be referenced or a written description of the analytical procedures to be used should be provided. Approved EPA procedures or their equivalent should be used.

Data Reduction, Validation, and Reporting - For each measurement, the data reduction scheme planned for collected data, including all equations used to calculate the concentration or value of the measured parameter, should be described. The principal criteria that will be used to validate the integrity of the data during collection and reporting should be referenced.

Internal Quality Control - All specific internal QC methods to be used should be identified. These methods include the use of replicates, spike samples, split samples, blanks, standards, and QC samples. Ways in which the QC information will be used to qualify the field data should be identified.

Performance and Systems Audits - The QAPP should describe the internal and external performance and systems audits that will be required to monitor the capability and performance of the total measurement system. The current *CLP Invitation for Bids* for organic and inorganic analyses may be referenced for CLP RAS performance and systems audits. The *Compendium of Superfund Field Operations Methods* (U.S. EPA, September 1987) may be referenced for routine fieldwork.

The systems audits consist of the evaluation of the components of the measurement systems to determine their proper selection and use. These audits include a careful evaluation of both field and laboratory QC procedures and are normally performed before or shortly after systems are operational. However, such audits should be performed on a regular schedule during the lifetime of the project or continuing operation. An onsite systems audit may be required for formal laboratory certification programs.

After systems are operational and are generating data, performance audits are conducted periodically to determine the accuracy of the total measurement system or its component parts. The QAPP should include a schedule for conducting performance audits for each measurement parameter. Laboratories may be required to participate in the analysis of performance evaluation samples related to specific projects. Project plans should also indicate, where applicable, scheduled participation in all other interlaboratory performance evaluation studies.

In support of performance audits, the environmental monitoring systems and support laboratories provide necessary audit materials and devices, as well as technical assistance. These laboratories conduct regular interlaboratory performance tests and provide guidance and assistance in the conduct of systems audits. The laboratories should be contacted if assistance is needed in the above areas.

Preventive Maintenance - A schedule should be provided of the major preventative maintenance tasks that will be carried out to minimize downtime of field and laboratory instruments. Owner's manuals may be referenced for field equipment.

Specific Routine Procedures Used to Assess Data (Precision, Accuracy, and Completeness) - The precision and accuracy of data must be routinely assessed for all environmental monitoring and measurement data. The QAPP should describe specific procedures to accomplish this assessment. If enough data are generated, statistical procedures may be used to assess the precision, accuracy, and completeness. If statistical procedures are used, they should be documented.

Corrective Actions - In the context of QA, corrective actions are procedures that might be implemented on samples that do not meet QA specifications. Corrective actions are usually addressed on a case-by-case basis for each project. The need for corrective actions is based on predetermined limits for acceptability. Corrective actions may include resampling, reanalyzing samples, or auditing laboratory procedures. The QAPP should identify persons responsible for initiating these actions, procedures for identifying and documenting corrective actions, and procedures for reporting and followup.

Quality Assurance Project Plans - QAPPs should identify the method to be used to report the performance of measurement systems and data quality. This reporting should include results of performance audits, results of systems audits, and significant QA problems encountered, along with recommended solutions. The RI report should include a separate QA section that summarizes the data quality.

IV. Elements of a Field Sampling Plan^{*}

Site Background - If the analysis of existing data is not included in the work plan or QAPP, it must be included in the FSP. This analysis would include a description of the site and surrounding areas and a discussion of known and suspected contaminant sources, probable transport pathways, and other information about the site. The analysis should also include descriptions of specific data gaps and ways in which sampling is designed to fill those gaps. Including this discussion in the FSP will help orient the sampling team in the field.

Sampling Objectives - Specific objectives of a sampling effort that describe the intended uses of data should be clearly and succinctly stated.

Sample Location and Frequency - This section of the sampling plan identifies each sample matrix to be collected and the constituents to be analyzed. A table may be used to clearly identify the number of samples to be collected along with the appropriate number of replicates and blanks. A figure should be included to show the locations of existing or proposed sample points.

Sample Designation - A sample numbering system should be established for each project. The sample designation should include the sample or well number, the sampling round, the sample matrix (e.g., surface soil, ground water, soil boring), and the name of the site.

Sampling Equipment and Procedures - Sampling procedures must be clearly written. Step-by-step instructions for each type of sampling are necessary to enable the field team to gather data that will meet the DQOs. A list should include the equipment to be used and the material composition (e.g., Teflon, stainless steel) of the equipment along with decontamination procedures.

Sample Handling and Analysis - A table should be included that identifies sample preservation methods, types of sampling jars, shipping requirements, and holding times. SAS requests and CLP SOWs may be referenced for some of this information.

Examples of paperwork and instructions for filling out the paperwork should be included. Use of the CLP requires that traffic reports, chain-of-custody forms, SAS packing lists, and sample tags be filled out for each sample. If other laboratories are to be used, the specific documentation required should be

^{*}Field sampling plans are site-specific and may include additional elements.

identified. Field documentation includes field notebooks and photographs.

Provision should be made for the proper handling and disposal of wastes generated onsite. The site-specific procedures need to be described to prevent contamination of clean areas and to comply with existing regulations.

V. Elements of a Health and Safety Plan

1. The name of a site health and safety officer and the names of key personnel and alternates responsible for site safety and health
2. A health and safety risk analysis for existing site conditions, and for each site task and operation
3. Employee training assignments
4. A description of personal protective equipment to be used by employees for each of the site tasks and operations being conducted
5. Medical surveillance requirements
6. A description of the frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used
7. Site control measures
8. Decontamination procedures
9. Standard operating procedures for the site
10. A contingency plan that meets the requirements of 29 CFR 1910.120(I)(1) and (I)(2)
11. Entry procedures for confined spaces

Appendix C

Model Statement of Work for Remedial Investigations and Feasibility Studies

Introduction

This model statement of work (SOW) was developed to provide users of this guidance with an illustrative example of how the specific tasks¹ carried out during a remedial investigation (RI) and feasibility study (FS) may be presented. Because an RI/FS is phased in accordance with a site's complexity and the amount of available information, it may be necessary to modify components of the SOW in order to tailor the tasks to the specific conditions at a site. Similarly, the level of detail and the specification of individual tasks will vary according to the budget, size, and complexity of the contract. Therefore, a SOW may differ, or

additional tasks may be added to what is presented here.

A SOW should begin with a section identifying the site, its regulatory history, if any, and a statement and discussion of the purpose and objectives of the RI/FS within the context of that particular site. This section should be followed by a discussion of the specific tasks that will be necessary to meet the stated objectives. The SOW should be accompanied by U.S. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988).

¹REM contractor standard tasks have been developed for cost accounting purposes (see Appendix B) and are the basis of the format of this model SOW.

Model SOW for Conducting an R/IFS

Purpose

The purpose of this remedial investigation/feasibility study (RI/FS) is to investigate the nature and extent of contamination at the OTR site and to develop and evaluate remedial alternatives, as appropriate. The contractor will furnish all necessary personnel, materials, and services needed for, or incidental to, performing the RI/FS, except as otherwise specified herein. The contractor will conduct the RI/FS in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA, October 1988).

This statement of work (SOW) has been developed for the OTR site that operated as a former drum recycling center from 1968 through 1979. OTR was proposed for inclusion to the NPL in September 1980 and appeared as final on the NPL in September 1981. A removal action taken in 1982 removed all visible drums and disposed of them in an offsite landfill. Three buildings remain onsite along with visibly stained soil that is assumed to be contaminated with TCE, benzene, and other organics. It is suspected that releases from the site have contaminated nearby surface waters and ground waters beneath the site.

Scope

The specific RI/FS activities to be conducted at the OTR site are segregated into 11 separate tasks.

- Task 1 - Project Planning
- Task 2 - Community Relations
- Task 3 - Field Investigations
- Task 4 - Sample Analysis/Validation
- Task 5 - Data Evaluation
- Task 6 - Risk Assessment
- Task 7 - Treatability Studies
- Task 8 - RI Report(s)

- Task 9 - Remedial Alternatives Development and Screening
- Task 10 - Detailed Analysis of Alternatives
- Task 11 - FS Report(s)

The contractor shall specify a schedule of activities and deliverables, a budget estimate, and staffing requirements for each of the tasks which are described below.

Task 1 Project Planning

Upon receipt of an interim authorization memorandum (used to authorize work plan preparation) and this SOW from U.S. EPA outlining the general scope of the project, the contractor shall begin planning the specific RI/FS activities that will need to be conducted. As part of this planning effort, the contractor will compile existing information (e.g., topographic maps, aerial photographs, data collected as part of the NPL listing process, and data collected as part of the drum removal of 1982) and conduct a site visit to become familiar with site topography, access routes, and the proximity of potential receptors to site contaminants. Based on this information (and any other available data), the contractor will prepare a site background summary that should include the following:

- *Local Regional Summary* - A summary of the location of the site, pertinent area boundary features and general site physiography, hydrology, geology, and the location(s) of any nearby drinking water supply wells.
- *Nature and Extent of Problem* - A summary of the actual and potential onsite and offsite health and environmental effects posed by any remaining contamination at the site. Emphasis should be on providing a conceptual understanding of the sources of contamination, potential release mechanisms, potential routes of migration, and potential human and environmental receptors.
- *History of Regulatory and Response Actions* - A summary of any previous response actions conducted by local, State, Federal, or private

parties. This summary should address any enforcement activities undertaken to identify responsible parties, compel private cleanup, and recover costs. Site reference documents and their locations should be identified.

- *Preliminary Site Boundary* - A preliminary site boundary to define the initial area(s) of the remedial investigation. This preliminary boundary may also be used to define an area of access control and site security.

The contractor will meet with EPA to discuss the following:

- The proposed scope of the project and the specific investigative and analytical activities that will be required
- Whether there is a need to conduct limited sampling to adequately scope the project and develop project plans
- Preliminary remedial action objectives and general response actions
- Potential remedial technologies and the need for or usefulness of treatability studies
- Potential ARARs associated with the location and contaminants of the site and the potential response actions being contemplated
- Whether a temporary site office should be set up to support site work

Once the scope has been agreed upon with EPA, the contractor will (1) develop the specific project plans to meet the objectives of the RI/FS² and (2) initiate subcontractor procurement and coordination with analytical laboratories. The project plans will include: a work plan which provides a project description and outlines the overall technical approach, complete with corresponding personnel requirements, activity schedules, deliverable due dates, and budget estimates for each of the specified tasks; a sampling and analysis plan [composed of the field sampling plan (FSP) and the quality assurance project plan (QAPP)]; a health and safety plan; and a community relations plan. The latter three plans are described below.

Sampling and Analysis Plan - The contractor will prepare a SAP which will consist of the following:

² At some sites it may be necessary to submit an interim work plan initially until more is learned about the site. A subsequent, more thorough project planning effort can then be used to develop final workplans.

Field Sampling Plan. The FSP should specify and outline all necessary activities to obtain additional site data. It should contain an evaluation explaining what additional data are required to adequately characterize the site, conduct a baseline risk assessment, and support the evaluation of remedial technologies in the FS. The FSP should clearly state sampling objectives; necessary equipment; sample types, locations, and frequency; analyses of interest; and a schedule stating when events will take place and when deliverables will be submitted.

Quality Assurance Project Plan. The QAPP should address all types of investigations conducted and should include the following discussions:

- A project description (should be duplicated from the work plan)
- A project organization chart illustrating the lines of responsibility of the personnel involved in the sampling phase of the project
- Quality assurance objectives for data such as the required precision and accuracy, completeness of data, representativeness of data, comparability of data, and the intended use of collected data
- Sample custody procedures during sample collection, in the laboratory, and as part of the final evidence files
- The type and frequency of calibration procedures for field and laboratory instruments, internal quality control checks, and quality assurance performance audits and system audits
- Preventative maintenance procedures and schedule and corrective action procedures for field and laboratory instruments
- Specific procedures to assess data precision, representativeness, comparability, accuracy, and completeness of specific measurement parameters
- Data documentation and tracking procedures

Standard operating procedures for QA/QC that have been established within EPA will be referenced and not duplicated in the QAPP.

Health and Safety Plan - The contractor will develop an HSP on the basis of site conditions to protect personnel involved in site activities and the surrounding community. The plan should address all applicable regulatory requirements contained in 20 CFR 1910.120(i)(2) - Occupational Health and Safety Administration, Hazardous Waste Operations and Emergency Response, Interim Rule, December 19, 1986; U.S. EPA Order 1440.2 - Health and Safety

Requirements for Employees Engaged in Field Activities; U.S. EPA Order 1440.3 - Respiratory Protection; U.S. EPA Occupational Health and Safety Manual; and U.S. EPA Interim Standard Operating Procedures (September, 1982). The plan should provide a site background discussion and describe personnel responsibilities, protective equipment, health and safety procedures and protocols, decontamination procedures, personnel training, and type and extent of medical surveillance. The plan should identify problems or hazards that may be encountered and how these are to be addressed. Procedures for protecting third parties, such as visitors or the surrounding community, should also be provided. **Standard operating procedures for ensuring worker safety should be referenced and not duplicated in the HSP.**

Community Relations Plan - The contractor will prepare a community relations plan on how citizens want to be involved in the process based on interviews with community representatives and leaders. The CLP will describe the types of information to be provided to the public and outline the opportunities for community comment and input during the RI/FS. Deliverables, schedule, staffing, and budget requirements should be included in the plan.

The work plan and corresponding activity plans will be submitted to EPA as specified in the contract or as discussed in the initial meeting(s). The contractor will provide a quality review of all project planning deliverables.

Task 2 Community Relations

The contractor will provide the personnel, services, materials, and equipment to assist EPA in undertaking a community relations program. This program will be integrated closely with all remedial response activities to ensure community understanding of actions being taken and to obtain community input on RI/FS progress. Community relations support provided by the contractor will include, but may not be limited to, the following:

- Revisions or additions to community relations plans, including definition of community relations program needs for each remedial activity
- Establishment of a community information repository(ies), one of which will house a copy of the administrative record
- Preparation and dissemination of news releases, fact sheets, slide shows, exhibits, and other audio-visual materials designed to apprise the community of current or proposed activities

- Arrangements of briefings, press conferences, workshops, and public and other informal meetings
- Analysis of community attitudes toward the proposed actions
- Assessment of the successes and failures of the community relations program to date
- Preparation of reports and participation in public meetings, project review meetings, and other meetings as necessary for the normal progress of the work
- Solicitation, selection, and approval of subcontractors, if needed

Deliverables and the schedule for submittal will be identified in the community relations plan discussed under Task 1.

Task 3 Field Investigations

The contractor will conduct those investigations necessary to characterize the site and to evaluate the actual or potential risk to human health and the environment posed by the site. Investigation activities will focus on problem definition and result in data of adequate technical content to evaluate potential risks and to support the development and evaluation of remedial alternatives during the FS. The aerial extent of investigation will be finalized during the remedial investigation.

Site investigation activities will follow the plans developed in Task 1. Strict chain-of-custody procedures will be followed and all sample locations will be identified on a site map. The contractor will provide management and QC review of all activities conducted under this task. Activities anticipated for this site are as follows:

- *Surveying and Mapping of the Site*³ - Develop a map of the site that includes topographic information and physical features on and near the site. If no detailed topographic map for the site and surrounding area exists, a survey of the site will be conducted. Aerial photographs should be used, when available, along with information gathered during the preliminary site visit to identify physical features of the area.
- *Waste Characterization* - Determine the location, type, and quantities as well as the physical or chemical characteristics of any waste remaining at the site. If hazardous substances are held in

³May be conducted under Task 1 as part of the site visit or limited investigation.

containment vessels, the integrity of the containment structure and the characteristics of the contents will be determined.

- **Hydrogeologic Investigation** - Determine the presence and potential extent of ground water contamination. Efforts should begin with a survey of previous hydrogeologic studies and other existing data. The survey should address the soil's retention capacity/mechanisms, discharge/recharge areas, regional flow directions and quality, and the likely effects of any alternatives that are developed involving the pumping and disruption of ground water flow. Results from the sampling program should estimate the horizontal and vertical distribution of contaminants, the contaminants' mobility, and predict the long-term disposition of contaminants.
- **Soils and Sediments Investigation** - Determine the vertical and horizontal extent of contamination of surface and subsurface soils and sediments and identify any uncertainties with this analysis. Information on local background levels, degree of hazard, location of samples, techniques used, and methods of analysis should be included. If initial efforts indicate that buried waste may be present, the probable locations and quantities of these subsurface wastes should be identified through the use of appropriate geophysical methods.
- **Surface Water Investigation** - Estimate the extent and fate of any contamination in the nearby surface waters. This effort should include an evaluation of possible future discharges and the degree of contaminant dilution expected.
- **Air Investigation** - Investigate the extent of atmospheric contamination from those contaminants found to be present at the site. This effort should assess the potential of the contaminants to enter the atmosphere, local wind patterns, and the anticipated fate of airborne contaminants.

Information from this task will be summarized and included in the RI/FS report appendixes.

Task 4 Sample Analysis/Validation

The contractor will develop a data management system including field logs, sample management and tracking procedures, and document control and inventory procedures for both laboratory data and field measurements to ensure that the data collected during the investigation are of adequate quality and quantity to support the risk assessment and the FS. Collected data should be validated at the appropriate field or laboratory QC level to determine whether it is appropriate for its intended use. Task management

and quality controls will be provided by the contractor. The contractor will incorporate information from this task into the RI/FS report appendixes.

Task 5 Data Evaluation

The contractor will analyze all site investigation data and present the results of the analyses in an organized and logical manner so that the relationships between site investigation results for each medium are apparent. The contractor will prepare a summary that describes (1) the quantities and concentrations of specific chemicals at the site and the ambient levels surrounding the site; (2) the number, locations, and types of nearby populations and activities; and (3) the potential transport mechanism and the expected fate of the contaminant in the environment.

Task 6 Risk Assessment

The contractor shall conduct a baseline risk assessment to assess the potential human health and environmental risks posed by the site in the absence of any remedial action. This effort will involve four components: contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

- **Contaminant Identification** - The contractor will review available information on the hazardous substances present at the site and identify the major contaminants of concern. Contaminants of concern should be selected based on their intrinsic toxicological properties because they are present in large quantities, and/or because they are currently in, or potentially may migrate into, critical exposure pathways (e.g., drinking water).
- **Exposure Assessment** - The contractor will identify actual or potential exposure pathways, characterize potentially exposed populations, and evaluate the actual or potential extent of exposure.
- **Toxicity Assessment** - The contractor will provide a toxicity assessment of those chemicals found to be of concern during site investigation activities. This will involve an assessment of the types of adverse health or environmental effects associated with chemical exposures, the relationships between magnitude of exposures and adverse effects, and the related uncertainties for contaminant toxicity, (e.g., weight of evidence for a chemical's carcinogenicity).
- **Risk Characterization** - The contractor will integrate information developed during the exposure and toxicity assessments to characterize the current or potential risk to human health and/or the environment posed by the site. This characterization should identify the potential

for adverse health or environmental effects for the chemicals of concern and identify any uncertainties associated with contaminant(s), toxicity(ies), and/or exposure assumptions.

The risk assessment will be submitted to EPA as part of the RI report.

Task 7 Treatability Studies

The contractor will conduct bench and/or pilot studies as necessary to determine the suitability of remedial technologies to site conditions and problems. Technologies that may be suitable to the site should be identified as early as possible to determine whether there is a need to conduct treatability studies to better estimate costs and performance capabilities. Should treatability studies be determined to be necessary, a testing plan identifying the types and goals of the studies, the level of effort needed, a schedule for completion, and the data management guidelines should be submitted to EPA for review and approval. Upon EPA approval, a test facility and any necessary equipment, vendors, and analytical services will be procured by the contractor.

Upon completion of the testing, the contractor will evaluate the results to assess the technologies with respect to the goals identified in the test plan. A report summarizing the testing program and its results should be prepared by the contractor and presented in the final RI/FS report. The contractor will implement all management and QC review activities for this task.

Task 8 RI Report

Monthly reports will be prepared by the contractor to describe the technical and financial progress at the OTR site. Each month the following items will be reported:

- Status of work and the progress to date
- Percentage of the work completed and the status of the schedule
- Difficulties encountered and corrective actions to be taken
- The activity(ies) in progress
- Activities planned for the next reporting period
- Any changes in key project personnel
- Actual expenditures (including fee) and direct labor hours for the reporting period and for the cumulative term of the project

- Projection of expenditures needed to complete the project and an explanation of significant departures from the original budget estimate

Monthly reports will be submitted to U.S. EPA as specified in the contract. In addition, the activities conducted and the conclusions drawn during the remedial investigation (Tasks 3 through 7) will be documented in an RI report (supporting data and information should be included in the appendixes of the report). The contractor will prepare and submit a draft RI report to EPA for review. Once comments on the draft RI report are received, the contractor will prepare a final RI report reflecting these comments.

Task 9 Remedial Alternatives Development and Screening

The contractor will develop a range of distinct, hazardous waste management alternatives that will remediate or control any contaminated media (soil, surface water, ground water, sediments) remaining at the site, as deemed necessary in the RI, to provide adequate protection of human health and the environment. The potential alternatives should encompass, as appropriate, a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes but vary in the degree to which long-term management of residuals or untreated waste is required, one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve minimal efforts to reduce potential exposures (e.g., site fencing, deed restrictions) should be presented as "limited action" alternatives.

The following steps will be conducted to determine the appropriate range of alternatives for this site:

- **Establish Remedial Action Objectives and General Response Actions**^{*} - Based on existing information, site-specific remedial action objectives to protect human health and the environment should be developed. The objectives should specify the contaminant(s) and media of concern, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

Preliminary remediation goals should be established based on readily available information (e.g., RfDs) or chemical-specific ARARs (e.g., MCLs). The contractor should meet with EPA to discuss the remedial action objectives for the site. As more information is collected during the RI, the contractor,

^{*}Preliminary remedial action objectives are developed as part of the project planning phase.

in consultation with EPA, will refine remedial action objectives as appropriate.

General response actions will be developed for each medium of interest defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination to satisfy remedial action objectives. Volumes or areas of media to which general response actions may apply shall be identified, taking into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

- **Identify and Screen Technologies** - Based on the developed general response actions, hazardous waste treatment technologies should be identified and screened to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to effectively address the contaminants at the site, but will also take into account a technology's implementability and cost. The contractor will select representative process options, as appropriate, to carry forward into alternative development. The contractor will identify the need for treatability testing (as described under Task 7) for those technologies that are probable candidates for consideration during the detailed analysis.
- **Configure and Screen Alternatives** - The potential technologies and process options will be combined into media-specific or sitewide alternatives. The developed alternatives should be defined with respect to size and configuration of the representative process options; time for remediation; rates of flow or treatment; spatial requirements; distances for disposal; and required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct, viable options are available and developed, a screening of alternatives will be conducted to limit the number of alternatives that undergo the detailed analysis and to provide consideration of the most promising process options. The alternatives should be screened on a general basis with respect to their effectiveness, implementability, and cost. The contractor will meet with EPA to discuss which alternatives will be evaluated in the detailed analysis and to facilitate the identification of action-specific ARARs.

Task 10 Detailed Analysis of Alternatives

The contractor will conduct a detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of evaluation criteria

and a comparative analysis of all options against the evaluation criteria with respect to one another.

The evaluation criteria are as follows:

- **Overall Protection of Human Health and the Environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- **Compliance with ARARs** addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provide grounds for invoking a waiver.
- **Long-Term Effectiveness and Permanence** refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment** is the anticipated performance of the treatment technologies a remedy may employ.
- **Short-Term Effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.
- **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.
- **Cost** includes estimated capital and operation and maintenance costs, and net present worth costs.
- **State Acceptances** (Support Agency) addresses the technical or administrative issues and concerns the support agency may have regarding each alternative.
- **Community Acceptance**^a addresses the issues and concerns the public may have to each of the alternatives.

The individual analysis should include: (1) a technical description of each alternative that outlines the waste management strategy involved and identifies the key

^aThese criteria will be addressed in the ROD once comments on the RI/FS report and proposed plan have been received and will not be included in the RI/FS report..

ARARs associated with each alternative; and (2) a discussion that profiles the performance of that alternative with respect to each of the evaluation criteria. A table summarizing the results of this analysis should be prepared. Once the individual analysis is complete, the alternatives will be compared and contrasted to one another with respect to each of the evaluation criteria.

Task 11 FS Report(s)

Monthly contractor reporting requirements for the FS are the same as those specified for the RI under Task 8.

The contractor will present the results of Tasks 9 and 10 in a FS report. Support data, information, and calculations will be included in appendixes to the report. The contractor will prepare and submit a draft FS report to EPA for review. Once comments on the draft FS have been received, the contractor will prepare a final FS report reflecting the comments.¹ Copies of the final report will be made and distributed to those individuals identified by EPA.

¹The final FS report may be bound with the final RI report.

Appendix D

Bibliography of Technology Process Resource Documents

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Appendix E

Documentation of ARARs

The accompanying table presents a suggested format for summarizing the identification and documentation of ARARs in the RI/FS process. This format assumes that two previous ARARs identification steps have taken place during the RI/FS. First, it assumes that a list of Federal and State ARARs has been developed through consultations between the lead and support agencies. This list should include chemical-, location-, and action-specific requirements and, in the case of multiple ARARs (e.g., both a Federal and State requirement for a particular chemical), the ARAR to be used for the site or alternative (generally the more stringent) should be specified. Second, it assumes that the key requirements and the reasons for their applicability or relevance and appropriateness have been integrated into the narrative descriptions of each alternative as part of the "Detailed Analysis" chapter in the FS report. This appendix, therefore, serves as a summary of the ARARs for each alternative and indicates whether the alternative is anticipated to meet those ARARs, or, if not, what type of waiver would be justified.

The suggested format for the documentation of ARARs is presented here in the form of an example. The example is intended for illustrative purposes only; the ARARs identified for the sample alternatives may not be appropriate in a specific site situation.

The site in the example was a battery and cleaning solution storage facility operated and closed prior to the effective date of the RCRA hazardous waste storage regulations. The site is also located in a floodplain. The site consists of two areas of contaminated soil: Area 1 is contaminated with lead; Area 2 is contaminated with TCE. There is also a ground water plume associated with the site that contains levels of TCE as high as 100 ppb and lead as high as 500 ppb. The alternatives evaluated in detail for the site are:

- Alternative 1 - No action
- Alternative 2 - Capping of the contaminated soil; natural attenuation of the ground water
- Alternative 3 - In situ soil vapor extraction of the TCE-contaminated soil; capping of the lead-

contaminated soil; ground water pump/treat with offsite discharge to a nearby creek

- Alternative 4 - In situ soil vapor extraction of the TCE-contaminated soil; in situ fixation of the lead-contaminated area, followed by a soil cap; ground water pump/treat with offsite discharge to a nearby creek
- Alternative 5 - Incineration of the TCE-contaminated soil; offsite disposal of nonhazardous ash in the Subtitle D facility; in situ fixation of the lead-contaminated soil, followed by a soil cap; ground water pump/treat with off site discharge to a nearby creek

For this example, it has been assumed that the TCE is not an RCRA-listed or characteristic waste but that the lead-contaminated area is hazardous because of its characteristic of EP toxicity. Following in-situ fixation, the lead-contaminated soil is anticipated to be nonhazardous. Because none of the alternatives involves the placement of RCRA hazardous waste (lead-contaminated soil), the land disposal restrictions are assumed to be neither applicable nor relevant and appropriate.

The example also assumes that post-closure care requirements of RCRA (e.g., ground water monitoring) will generally be relevant and appropriate wherever closure is performed with waste in place.

Finally, it is also assumed that the RCRA location standards, while not applicable because none of the alternatives involve RCRA-regulated treatment, storage, or disposal, are nonetheless relevant and appropriate to all the action alternatives. Typically, the rationale for determinations of applicability or relevance and appropriateness will be integrated into the description of alternatives in the detailed analysis of the FS report.

The following table identifies the applicable or relevant and appropriate requirements for each of the five alternatives, indicates whether the alternative is expected to achieve that standard, and notes any ARAR waivers that may be required-

Table E-1. Documentation of ARARS

Chemical-Specific	Alternative 1 No Action	Alternative 2 Cap Natural Attenuation	Alternative 3 In Situ SVE of TCE, Cap Lead Area, GW Pump/Treat	Alternative 4	Alternative 5
				In Situ SVE of TCE, In Situ Fixation, Cap of Lead Area, GW Pump/Treat	Incineration of TCE Soil/Offsite Disposal of Ash, In Si Fixation, Cap of Lead Area, GW Pump/Treat
TCE	5 ppb Federal MCL will not be achieved in ground water; no waiver is justified	5 ppb Federal MCL will be met in 30 years	5 ppb Federal MCL will be met in 10 years	See Alternative 3	See Alternative 3
Lead	Neither 50 ppb Federal MCL nor State standard of 20 ppb will be achieved in ground water; no waiver is justified	50 ppb Federal MCL will be met in 30 years; State standard of 20 ppb will not be met; technical impracticability waiver justified	50 ppb Federal MCL will be met in 10 years; State Standard of 20 ppb will not be met; technical impracticability waiver justified	See Alternative 3	See Alternative 3

Table E-1. Continued

<u>Location-Specific</u>		<u>Alternative 1</u> <u>No Action</u>	<u>Alternative 2</u> <u>Cap</u> <u>Natural Attenuation</u>	<u>Alternative 3</u> <u>In Situ SVE of TCE, Cap</u> <u>Lead Area, GW Pump/Treat</u>	<u>Alternative 4</u> <u>In Situ</u> <u>SVE of TCE, In Situ</u> <u>Fixation, Cap of Lead</u> <u>Area, GW Pump/Treat</u>	<u>Alternative 5</u> <u>Incineration</u> <u>of TCE Soil/Offsite</u> <u>Disposal of Ash, In Situ</u> <u>Fixation, Cap of Lead</u> <u>Area, GW Pump/Treat</u>
I.	RCRA location of TSD facility in 100-year floodplain (40 CFR 264.18)	--	Will meet	See Alternative 2	See Alternative 2	See Alternative 2
II.	Executive Order 11988 (Floodplain Management) Evaluate potential effects of actions, avoid adverse impacts to the extent possible (40 CFR 6, Appendix A)	--	Will meet	See Alternative 2	See Alternative 2	See Alternative 2
III.	State siting standard for new incinerators	--	--	--	--	Will meet substantive requirements of incinerator standards

Table E-1. Continued

Action-Specific	Alternative 1 No Action	Alternative 2 Cap Natural Attenuation	Alternative 3 In Situ SVE of TCE, Cap Lead Area, GW Pump/Treat	Alternative 4 In Situ SVE of TCE, In Situ Fixation, Cap of Lead Area, GW Pump/Treat	Alternative 5 Incineration of TCE Soil/Offsite Disposal of Ash, In Situ Fixation, Cap of Lead Area, GW Pump/Treat
I. Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (42 USCA 7401-7642)					
A. Closure and Post-Closure					
E-4 1. Clean Closure (40 CFR 264.111)	--	--	Will meet in Area 2 (TCE area)	Will meet in Area 2 (TCE area)	Will meet in Area 2 (TCE area)
2. Closure With Waste in Place (capping) (40 CFR 264.228)	Will not meet; no waiver is justified	Will meet	--	--	--
3. Post-Closure Care (40 CFR 264.310)	Will not meet; no waiver is justified	Will meet	--	--	--
B. Incineration (40 CFR 264.340-345)	--	--	--	--	Performance stan- dards will be met by onsite incinerator

Table E-1. Continued

Action-Specific	Alternative 1 No Action	Alternative 2 Cap Natural Attenuation	Alternative 3 In Situ SVE of TCE, Cap Lead Area, GW Pump/Treat	Alternative 4	Alternative 5
				In Situ SVE of TCE, In Situ Fixation, Cap of Lead Area, GW Pump/Treat	Incineration of TCE Soil/Offsite Disposal of Ash, In Situ Fixation, Cap of Lead Area, GW Pump/Treat
C. Solid Waste Disposal (40 CFR 241.200-212)	--	--	Will meet in Area 1	See Alternative 3	Non-hazardous residuals from incineration of TCE area will be dis- posed in an offsite Subtitle D facility; fixed lead will be capped
II. Clean Water Act (CWA) (33 USCA 1251 - 1376)					
A. National Pollutant Discharge Elimination System (NPDES) (40 CFR 122 - 125)	--	--	Permit for offsite discharge will be obtained	See Alternative 3	See Alternative 3
B. Water Quality Standards (CWA 402 (a) (1))	--	--	Compliance will occur by meeting NPDES limitations	See Alternative 3	See Alternative 3

E-5

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Appendix F

Case Example of Detailed Analysis

Introduction

Purpose

This appendix provides an example of how the results of the individual and comparative analyses of remedial alternatives may be presented in the FS report. As discussed in Chapter 6 of this guidance, the individual analysis consists of a narrative description of the alternative including a discussion of how the alternative performs with respect to each of the evaluation criteria¹. The comparative analysis that follows the individual analysis consists of a narrative discussion summarizing the relative performance of the alternatives in relation to one another.

The amount of information presented in a detailed analysis will depend on the complexity of the site and on the extent of investigations and analysis conducted. In addition, as noted in Chapter 6, the level of detail and extent of discussion for the individual subfactors under each criterion will vary based on the relevance of that particular criterion to the alternatives being considered and the scope of the action being taken. Therefore, the amount of detail required to adequately document the results of the evaluations and the specific subfactors that will actually be discussed may differ somewhat from that presented in this case example.

The reader should also keep in mind that an actual RI/FS report will typically include maps, plans, schematics, and cost details that would be presented in previous chapters of the report (e.g., Development and Screening of Alternatives) or in the detailed analysis chapter itself. The purpose of this particular example is to give readers an idea of the types of information that should be provided when describing individual alternatives and discussing their performance against the evaluation criteria.

¹The criteria are discussed in the following order: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Community and state acceptance will generally not be addressed until the ROD, following receipt of formal comments on the RI/FS report and the proposed plan.

Site Background

The site used in this example is an old battery and cleaning solution storage facility located in a rural area. Improper handling and storage activities at this site from 1968 to 1978 resulted in both soil and ground water contamination. The area of contamination referred to as Area 1 contains 25,000 cubic yards (cy) of contaminated soil with concentrations of lead exceeding 200 mg/kg (concentrations of lead reach 500 mg/kg at several locations within this area). There is also a discrete area of approximately 20,000 cy of TCE-contaminated soil at the site referred to as Area 2. Analysis of soil samples from this area show TCE concentrations up to 6 percent and slightly elevated levels of metals compared to background. Although the risk assessment did not identify a human health or environmental risk from these metals, there is a small possibility that hot spots of metal contamination may have been missed. The soils of both Areas 1 and 2 are fairly permeable. Figure F-1 presents a simplistic map of the site.

The affected aquifer is shallow, with the water table lying approximately 12 feet under the site, and is currently used for drinking water. This aquifer has the characteristics of a Class IIA aquifer as defined under U.S. EPA's Ground Water Classification System. The aquifer consists of fractured bedrock, making ground water containment technologies difficult to implement. Ground water extraction may also be difficult due to the fractured bedrock. A plume of TCE above the 5 mg/l Maximum Contaminant Level (MCL) (measured as high as 50 ppm) is estimated to be moving in the direction of residential wells at an interstitial velocity of 65 ft/yr. The nearest residential well is 600 feet from the site boundary and the plume of contaminated ground water is likely to reach the well in an estimated 1 to 3 years at concentrations exceeding federal drinking water standards. Sampling conducted during the RI shows that no existing residential wells are currently contaminated.

The exposure pathways of concern identified during the baseline risk assessment include direct contact with possible ingestion of contaminated soil (1×10^{-4} associated excess cancer risk), and potential ingestion of contaminated ground water in the future

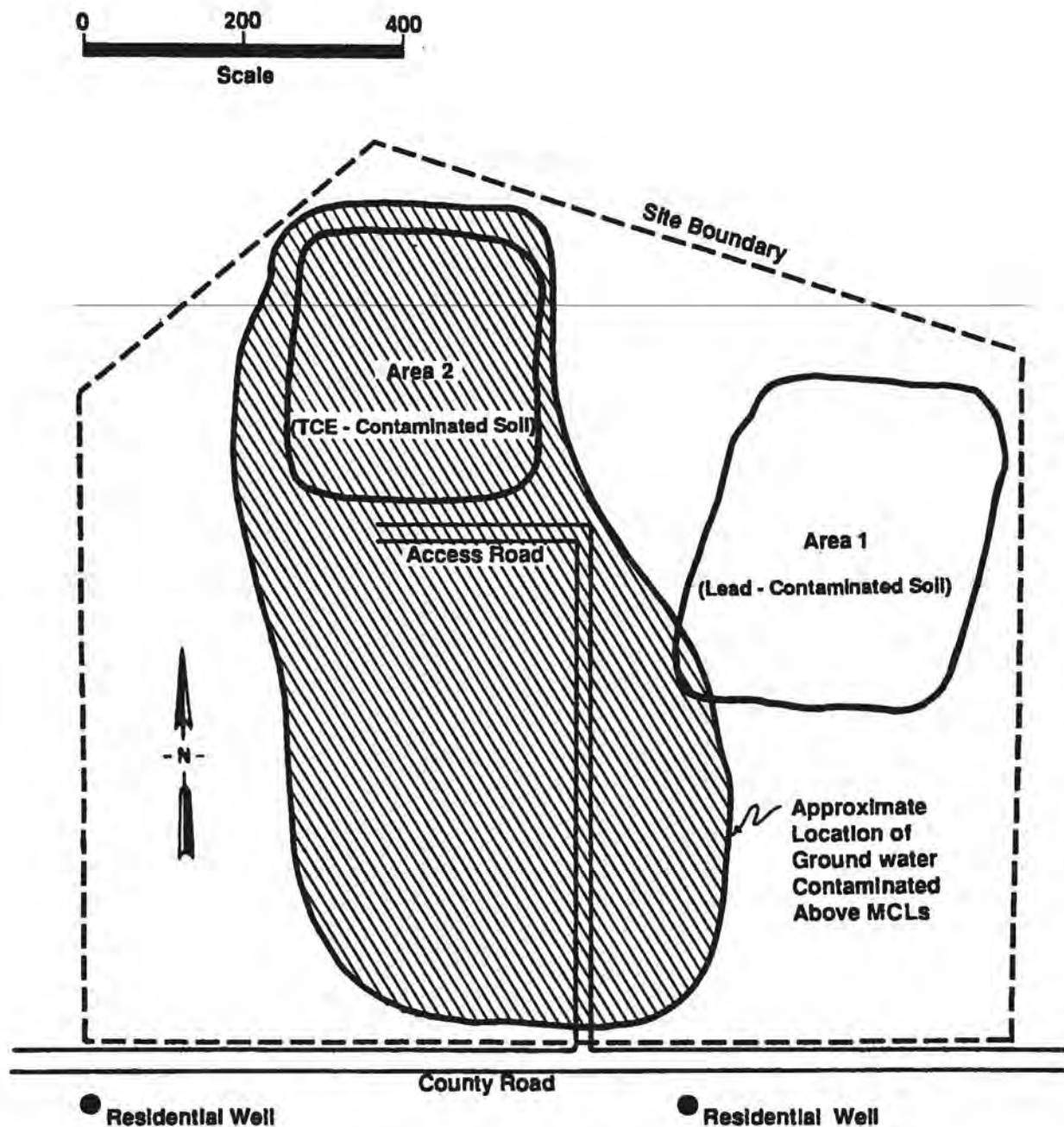


Figure F-1. Site map case example.

through existing or newly installed offsite wells (2×10^{-2} associated excess cancer risk). The MCL for TCE ($5 \mu\text{g/l}$) has been determined to be a relevant and appropriate remediation level for the contaminated ground water at this site since the ground water is used for drinking water. Based on the site-specific risk assessment, the MCL was

determined to be sufficiently protective as the aquifer remediation goal.

The risk assessment also concluded that 200 mg/kg for lead in soil would be a protective level for expected site exposures along with a 1×10^{-4}

excess cancer risk level for TCE-contaminated soil (56 ppm). Based on investigations of activities at the site, the TCE-contaminated soil has not been determined to be a listed, RCRA hazardous waste since the cleaning solution records indicate the solutions contained less than 10 percent TCE. However, the lead-contaminated soil is an RCRA hazardous waste by characteristic in this instance due to EP-toxicity. None of the waste is believed to have been disposed at the site after November 19, 1980 (the effective date for most of the RCRA treatment, storage, and disposal requirements).

The site is located in a state with an authorized RCRA program for closure which subsumes Federal requirements and specifies more stringent state requirements. Therefore, only the state closure requirements need to be analyzed for potential applicability or relevance and appropriateness to the remedial alternatives considered. No potential location-specific ARARs have been identified for this site.² Additionally, this example assumes that EPA and the State have agreed upon what non-ARAR information (i.e., guidance, advisories) is to be considered in designing the remedial alternatives.

Detailed Analysis - Case Example

Individual Analysis of Alternatives

The assembled remedial action alternatives represent a range of distinct waste management strategies which address the human health and environmental concerns associated with the site. Although the selected alternative will be further refined as necessary during the predesign phase, the description of the alternatives and the analysis with respect to the nine criteria presented below reflect the fundamental components of the various alternative hazardous waste management approaches being considered for this site.

The primary components of each alternative are listed in Figure F-2 and a technical description of these components is presented. After the technical description, a discussion of the alternative with respect to overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost follows.

The analysis of each alternative with respect to overall protection of human health and the environment provides a summary evaluation of how

the alternative reduces the risk from potential exposure pathways through treatment, engineering, or institutional controls. This evaluation also examines whether alternatives pose any unacceptable short-term or cross-media impacts.

The major Federal and State requirements that are applicable or relevant and appropriate to each alternative are identified. The ability of each alternative to meet all of its respective ARARs or the need to justify a waiver is noted for each.

Long-term effectiveness and permanence are evaluated with respect to the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste (untreated waste and treatment residuals) over the long-term. Alternatives that afford the highest degrees of long-term effectiveness and permanence are those that leave little or no waste remaining at the site such that long-term maintenance and monitoring are unnecessary and reliance on institutional controls is minimized.

The discussion on the reduction of toxicity, mobility, or volume through treatment addresses the anticipated performance of the treatment technologies a remedy may employ. This evaluation relates to the statutory preference for selecting a remedial action that employs treatment to reduce the toxicity, mobility, or volume of hazardous substances. Aspects of this criterion include the amount of waste treated or destroyed, the reduction in toxicity, mobility, or volume, the irreversibility of the treatment process, and the type and quantity of residuals resulting from any treatment process.

Evaluation of alternatives with respect to short-term effectiveness takes into account protection of workers and the community during the remedial action, environmental impacts from implementing the action, and the time required to achieve cleanup goals.

The analysis of implementability deals with the technical and administrative feasibility of implementing the alternatives as well as the availability of necessary goods and services. This criterion includes such items as: the ability to construct and operate components of the alternatives; the ability to obtain services, capacities, equipment, and specialists; the ability to monitor the performance and effectiveness of technologies; and the ability to obtain necessary approvals from other agencies.

The cost estimates presented in this report are order-of-magnitude level estimates. These costs are based on a variety of information including quotes from suppliers in the area of the site, generic unit costs, vendor information, conventional cost estimating guides, and prior experience. The feasibility study level cost estimates shown have been

²Determinations of what standards/requirements are applicable or relevant and appropriate are made on a site-specific basis and, in some cases, on an alternative-specific basis. Therefore, the ARAR determinations in this example should not be construed necessarily as appropriate rationales for such determinations at other sites.

		Alternative				
		1	2	3	4	5
Ground Water						
Monitoring			●	●	●	●
Natural Attenuation	N O A C T I O N		●			
Extraction Wells			●	●	●	
Onsite Air Stripping			●	●	●	
Soil						
Soil/Clay Cap (Area 1)			●	●	●	●
Soil/Clay Cap (Area 2)			●			
Fixation (Area 1)					●	●
Soil Vapor Extraction (Area 2)				●	●	
Onsite Incineration (Area 2)						●
Others						
Institutional Controls			●	●	●	●
Road Reconstruction			●	●	●	●
Fence			●	●	●	●

Figure F-2. Alternative components case example.

prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The actual costs of the project will depend on true labor and material costs, actual site conditions, competitive market conditions, final project scope, the implementation schedule, and other variable factors. A significant uncertainty that would affect the cost is the actual volumes of contaminated soil and ground water. Most of these uncertainties would affect all of the costs presented in this FS similarly.

Capital costs include those expenditures required to implement a remedial action. Both direct and indirect costs are considered in the development of capital cost estimates. Direct costs include construction costs or expenditures for equipment, labor, and materials required to implement a remedial action. Indirect costs include those associated with engineering, permitting (as required), construction management, and other services necessary to carry out a remedial action.

Annual O&M costs, which include operation labor, maintenance materials, and labor, energy, and

purchased services, have also been determined. The estimates include those O&M costs that may be incurred even after the initial remedial activity is complete. The present worth costs have been determined for 30 years at a 5 percent discount rate.

Alternative 1 - No Action

The no-action alternative provides a baseline for comparing other alternatives. Because no remedial activities would be implemented with the no-action alternative, long-term human health and environmental risks for the site essentially would be the same as those identified in the baseline risk assessment.

Criteria Assessment

Alternative 1 provides no control of exposure to the contaminated soil and no reduction in risk to human health posed through the ground water. It also allows for the possible continued migration of the contaminant plume and further degradation of the ground water.

Because no action is being taken, it would not meet any applicable or relevant and appropriate requirements such as the MCL for TCE.

This alternative includes no controls for exposure and no long-term management measures. All current and potential future risks would remain under this alternative.

This alternative provides no reduction in toxicity, mobility, or volume of the contaminated soil or ground water through treatment.

There would be no additional risks posed to the community, the workers, or the environment as a result of this alternative being implemented.

There are no implementability concerns posed by this remedy since no action would be taken.

The present worth cost and capital cost of Alternative 1 are estimated to be \$0 since there would be no action.

Alternative 2-5: Common Components

All of the remaining alternatives have four components in common (use of institutional controls, reconstruction of access road, erection of a fence around the site, and ground water monitoring). Although the description of these components is not repeated in the discussions for each alternative, differences in their planned implementation are identified where appropriate.

- **Institutional controls:** The current owner has agreed to allow the state to place a deed restriction on the site which would prohibit soil excavation and construction of buildings on any part of the site still containing hazardous materials upon completion of the remedy.³ In addition, a local ground water well regulation requiring state review of all installation plans for ground water wells would be used to prohibit the installation of drinking water supply wells in contaminated parts of the aquifer.
- **Road reconstruction:** Some of the road on the site (primarily near Area 2) would be restabilized and improved to allow construction activities and the movement of materials.
- **Fencing:** Approximately 1,600 feet of fencing would be installed around the perimeter of the site to restrict public access. Signs warning of the presence and potential danger of hazardous materials would be posted on the fence to further discourage unauthorized access to the site.

³The legal authority to implement deed restrictions will vary from state to state. Therefore, a key factor to consider during the evaluation of institutional controls is whether a particular state can actually impose restrictions on specific activities or whether their authorities are limited to nonenforceable actions such as deed notices.

- **Ground water monitoring:** Two new monitoring wells would be installed offsite. Analytical results from the new wells, some of the existing wells, and the residential wells would be used to monitor future conditions and to assess the effectiveness of the final action. Sampling would be conducted quarterly with four replicate samples at each well. The samples would be analyzed for volatiles and metals and results compared to background values using the Student's T-test. If the mean value of any compound at any facility boundary well is greater than background at the 0.05 significance level in two successive sampling rounds, appropriate investigative and remedial action(s) would be initiated as necessary.

Alternative 2 - Cap and Natural Attenuation

The primary components of Alternative 2 are capping of Areas 1 and 2 and natural attenuation of the contaminated ground water. Two caps would be installed, a 3-acre cap over Area 1 (lead-contaminated soil) and a 3-acre cap over Area 2 (TCE-contaminated soil). The cap would be consistent with the State RCRA landfill closure requirements. While these requirements are not applicable since the action does not involve the disposal of any RCRA hazardous waste, certain closure requirements have nevertheless been determined to be relevant and appropriate to this alternative. The State's RCRA requirements are more specific and stringent than the Federal requirements, which require a cap to have a permeability less than or equal to the permeability of natural underlying soil. The soil/clay caps would include a 2-foot thick compacted clay barrier layer with a permeability not to exceed 10^{-7} cm/sec, a geonet drainage layer, and a cover layer equal to the average frost level (approximately 3.5 feet) above the barrier layer. This cover layer would include 6 inches of topsoil and 3 feet of compacted native soil materials. The drainage layer and the extra frost protection depth are necessary because the rainfall rate would exceed surface runoff and evaporation rates, and the average frost depth (3.5 feet) is greater than the minimum 2 feet of cover recommended by U.S. EPA.

A geonet drainage layer was chosen for this alternative since the Hydrologic Evaluation of Landfill Performance (HELP) model showed it to be more effective than sand in controlling leachate production but it is comparable in cost. The HELP model predicted a 75 to 80 percent reduction in leachate production. Geotextile layers would be laid on either side of the geonet drain to prevent clogging. A minimum slope of 3 percent would be provided to meet state requirements. To achieve this slope, it is estimated that 4,000 cy of backfill material from elsewhere on the site would have to be placed prior to cap construction.

To determine the effect of natural attenuation on the contaminated ground water, two assumptions about the subsurface have been made. First, despite the fractured nature of the bedrock, it has been assumed that the subsurface is homogeneous to facilitate the evaluation. Second, the potential for reduction in TCE concentrations has been assessed using a hydrogeologic model. The model took into account the fact that the cap would reduce existing leachate production by 75 percent. This model predicted that the concentration of TCE in the ground water would be reduced to a 1×10^{-4} excess cancer risk level (280 $\mu\text{g/l}$) at the edge of the contaminated soil areas within 35 years, a 1×10^{-5} excess cancer risk level (28 $\mu\text{g/l}$) in 60 years, and a 1×10^{-6} excess cancer risk level (2.8 $\mu\text{g/l}$, approximately equal to the MCL) in approximately 100 years.

An alternate water supply would be included in this alternative to provide a safe and reliable source of drinking water until levels in the aquifer reached acceptable levels. The alternate system would consist of two new community wells* installed upgradient of the contamination, 1,000 to 2,000 feet from the site and a water main along the county road to feeder pipes for each resident. The required pumping capacity is estimated to be 100 gpm and the wells would provide water for the four residents located closest to the site, downgradient of the contaminated plume. The well water would be monitored for TCE and lead as part of the site-wide monitoring plan on a semiannual basis until the MCL levels are met and then thereafter consistent with the relevant and appropriate aspects of the RCRA post-closure care program.

Criteria Assessment

Although protective of human health since exposure to all contamination would be controlled, Alternative 2 would allow continued migration of the existing contaminated ground water. It would prevent exposure to the contaminated soil and would minimize further release of contaminants to the ground water by limiting future infiltration through the cap.

This alternative would control exposure to the contaminated ground water through provision of an alternate supply of drinking water and deed restrictions until the MCL for TCE is eventually reached. The ground water may require up to 100 years of natural attenuation to reach the chemical-specific ARAR of 5 $\mu\text{g/l}$ of TCE at the edge of the contaminated soil. Landfill closure requirements are not applicable to this alternative since the planned actions do not involve the disposal of any RCRA

hazardous waste; however, certain landfill closure requirements have been determined to be relevant and appropriate. This alternative would meet the RCRA landfill closure requirements by constructing a soil/clay cap that meets the State RCRA standards, and the guidance specifications that the lead and support agencies have agreed are to be considered (TBC).

In order for this alternative to remain effective over the long-term, careful maintenance of the alternate water supply through monitoring and periodic repair of pipes and pumps and careful maintenance of a healthy vegetative layer over the caps would be required. Any erosional damage of the caps would have to be repaired. Failure to address reduction in the cap's impermeability could result in increased leachate production, subsequent ground water contamination, and the potential for direct contact with the contaminated soil. Because the contaminated soil would remain onsite and because the ground water may remain contaminated above health-based levels for 100 years, long-term monitoring, maintenance, and control would be required under this alternative. An alternate water supply and institutional controls would be used to limit risk to present and potential future users of the contaminated ground water. The institutional controls would only be effective with a high degree of certainty in the short term, not over the long term; once all design and construction activities are complete. The local municipality cannot ensure the enforceability of the local water use regulation beyond a few years. Because this alternative would leave hazardous substances onsite, a review would be conducted at least every 5 years to ensure that the remedy continues to provide adequate protection of human health and the environment in accordance with CERCLA 121 (c).

This alternative would provide no reduction in the toxicity, mobility, or volume of the contaminated soil or ground water through treatment. The 20,000 cy of TCE-contaminated soil and 25,000 cy of lead-contaminated soil would remain onsite.

Within an estimated 6 months of beginning construction, the caps and the alternate water supply would be installed preventing direct exposure and reducing ground water contaminant migration. Provision of the alternate water supply would alleviate the risk from ingestion of contaminated ground water. The potential for a slight, temporary increase of risk to the community (and workers) due to particulate emissions during construction of the caps would be controlled through the use of dust control technologies (e.g., water or foam sprays).

No special techniques, materials, permits, or labor would be required to construct either the wells or caps. The native soil and clay are available locally,

*The actual location of these wells would be determined during predesign activities.

within 20 miles of the site. About 50,000 cy of soil and clay would be needed to construct the caps. The action could be enhanced by enlarging the caps if more contamination were discovered and by expanding the alternate water supply if more residents were affected than originally estimated.

The 30-year present worth cost of this alternative is estimated to be \$4,800,000, with a capital cost of \$4,200,000 and an annual O&M cost of \$60,000. The capital cost is primarily for the installation of the caps. The annual O&M costs are primarily for the ground water monitoring program and for maintaining the caps.

Alternative 3 - In Situ Soil Vapor Extraction, Cap, Ground Water Pump and Treat

This alternative consists of capping Area 1 (lead-contaminated soil) with the same soil/clay cap as described in Alternative 2 (2 feet of clay underlying a surface drainage layer and 3.5 feet of soil), using in situ vapor extraction to treat the TCE-contaminated soil in Area 2, extracting the ground water, and treating it onsite through an air stripping system and discharging it to a tributary of North Creek.

The soil vapor extraction technology involves collection of soil vapor from the unsaturated zone by applying a vacuum at a series of extraction points. The vacuum not only draws vapor from the unsaturated zone, but also decreases the pressure around the soil particles, thereby releasing additional volatiles. In addition, due to the pressure differential, clean air from the atmosphere enters the soil to replace the extracted air.

Pilot tests conducted during the RI showed vapor extraction to be a feasible and effective technology for removing TCE from the soil at this site. It is anticipated that the TCE can be removed to 56 ppm which is the 1×10^{-6} risk level for the direct contact exposure route within 3 to 5 years. This represents a 99.9 percent reduction in the concentration. To provide flexibility of operation, the contaminated area would be divided into two discrete areas, each with its own vapor extraction system. The major components of each vapor extraction system would include: 20 extraction wells, the necessary piping and valves, and a positive displacement blower (vacuum pump). The air discharged would be sent through two activated carbon units and the carbon would be regenerated for reuse.

Because the evacuation and collection of volatiles would be through a vacuum system, volatile contaminants would be controlled as a single point emission. The potential for fugitive losses of air contaminants would be minimal.

A ground water extraction scenario consisting of five wells at a combined pumping rate of 300 gpm was selected after a series of numerical simulations with a variety of well arrangements. This arrangement was found to provide more rapid restoration of the shallow aquifer than other arrangements evaluated (see Chapter # of the FS). The three onsite extraction wells would be located within the TCE plume but downgradient of its center. They would reverse the natural ground water flow direction offsite immediately, so the contaminants would not migrate further than their existing location. The residential wells should not be contaminated in the future. Because it was determined that the pumping rate should not depress the ground water table more than 10 feet, not all of the plume could be captured by the onsite wells. Two offsite wells would be used to remediate the area of the offsite contaminated aquifer.

The ground water model simulation for this scenario assumed that the soil remedial action would include treatment of the TCE-contaminated soil to levels indicated above, and that the lead-contaminated soil would be capped. The simulation indicated that the shallow aquifer could be restored to 5 mg/l (MCL) in 25 to 40 years. Without soil remediation, from 60 to 100 years would be required. Monitoring would be used to determine when the ground water cleanup goal of 5 µg/l had been reached at the boundaries of the waste management area and to evaluate the effectiveness of the alternative.

To treat the extracted ground water, an air stripper would be constructed on the site. The air stripper would be a counter-current packed tower, where air enters at the bottom and exhausts at the top while the ground water flows down through the media. The air stripper would be approximately 45 feet tall and 4 feet in diameter and would be designed to meet the performance goal of 5 mg/l TCE concentrations. The exhaust air would be discharged through carbon beds to collect the volatiles by adsorption. The carbon would be sent offsite for regeneration upon bed exhaustion. Because little iron or other metals are in the ground water, no pretreatment to prevent fouling of the air stripper would be required.

Upon completion of ground water treatment, the water would be discharged offsite to the nearby tributary of North Creek. An NPDES permit would be obtained before implementation.

Criteria Assessment

This alternative would protect both human health and the environment. Soil vapor extraction and the cap over the contaminated soil would reduce risk to human health by direct contact and soil ingestion. Ground water extraction and onsite treatment would reduce the threat to human health by ingestion of

contaminated ground water, and reduce the possibility of further environmental degradation.

This alternative would meet the MCL for TCE. To meet action-specific ARARs, the air treatment systems for this alternative would be designed to meet State air pollution control standards. Preliminary analysis also indicates that the ground water treatment system can be designed to meet State NPDES limitations which will result in no exceedances of the Water Quality Standards in the creek. Because the treatment of the TCE-contaminated soil would be conducted entirely in situ and the TCE is not a listed, RCRA hazardous waste, placement of RCRA hazardous waste would not occur and the land disposal restrictions would not be applicable nor relevant and appropriate. The cap constructed over Area 1 would meet the State RCRA requirements for landfill closure as under Alternative 2.

To provide for long-term effectiveness of this alternative, careful maintenance of the controls would be needed. As discussed for Alternative 2, the alternate water supply and cap would require maintenance. Further ground water contamination is reduced by removal of TCE through soil vapor extraction. Because lead is not expected to migrate rapidly, failure of the cap would increase the potential risk through direct contact but pose little or no concern for further ground water contamination. Human health risks posed by ingestion of ground water in the future would be reduced to less than 5 $\mu\text{g/l}$ by the pump and treat systems. However, because of the fractured nature of the bedrock, the ability of the pump and treat system to effectively reach the cleanup goal is somewhat uncertain. To determine its long-term effectiveness and to lessen the uncertainty of reaching cleanup goals, the ground water pump and treat systems would be monitored under a long-term program. Necessary modifications to either system would be made based on monitoring results. The area treated by soil vapor extraction would not require any additional maintenance or monitoring upon completion of the technology. This alternative also would require a 5-year review.

Vapor extraction is an irreversible treatment process that would reduce the toxicity of contaminated soil by removing over 99.9 percent of TCE from 20,000 cy of soil. The TCE would be collected on carbon.⁵ The air stripper would also reduce the toxicity and mobility of TCE in the ground water. Contaminants in the air stream would be collected on carbon and destroyed during regeneration making this ground water treatment component irreversible. This alternative would leave 25,000 cy of untreated lead-

contaminated soil onsite under a soil/clay cap. This alternative meets the statutory preference for using treatment as a principal element since the principal threats are addressed through treatment.

During operation of the vapor extraction system, the contaminated soil would remain uncovered, although the fence to be installed around the site would discourage trespassers and limit potential exposure. Although unlikely, the possibility of a small additional risk through inhalation to the community would exist if the extracted air collection system were to fail. As with the soil vapor extraction system, there is the slight additional risk of failure of the air collection system on the air stripper. Safety techniques including monitoring the equipment would be used to minimize any failures of the components. Once the extraction and treatment systems are installed, the contaminant plume would begin to recede from its current position. Between 25 and 40 years would be required to reach ground water remediation goals, and 3 to 5 years of soil vapor extraction would be required to reach soil remediation goals.

This alternative involves the use of proven technologies. The cap requires 25,000 cy of soil and clay to be brought to the site, placed, and graded to construct the cap. The onsite air stripper and both gaseous carbon adsorption systems require available equipment. Operation of the alternative would require frequent monitoring of the ground water and the air to assess the effectiveness of the soil vapor extraction and ground water extraction and treatment systems. Controlling operating conditions would be necessary to improve the effectiveness of these systems. Soil vapor extraction uses reliable equipment. Engineering judgment would be required during operation to determine the operating parameters of the alternative, such as air flow rate in the air stripper, the blower speed in the vapor extraction system, and TCE in the exhaust gas. All of the components could be expanded if additional contamination were discovered. The 30-year present worth cost is estimated to be \$7,300,000 with a projected \$3,300,000 for capital expenditures and \$440,000 for year 1 annual O&M costs. The most expensive item is the soil/clay cap followed by the ground water treatment system. The O&M costs would cover operating the soil and ground water treatment systems from year 1 to 5. After year 5 the O&M costs would drop to approximately \$200,000 to continue ground water treatment and monitoring.

Alternative 4 - In Situ Soil Vapor Extraction, In Situ Soil Fixation, Cap, and Ground Water Pump and Treat

This alternative includes in situ soil vapor extraction of TCE-contaminated soil (Area 2), in situ soil fixation of lead-contaminated soil (Area 1), cap (Area 1), and

⁵TCE would be destroyed by incineration when the carbon is regenerated.

ground water pump and treat components of Alternative 3.

The moisture content of the soil has been determined to be approximately 50 percent under worst case conditions. Using this information and results from vendor tests, it has been determined that a minimum dose of one part solidification reagent to two parts soil is required for migration control of lead. Testing has shown that the optimum solidification reagent mixture would consist of approximately 50 percent fly ash and 50 percent kiln dust. Thus, approximately 7,000 tons each of fly ash and cement kiln dust would be required. The reagents would be added in situ with a backhoe. As one area of the soil is fixed, the equipment could be moved onto the fixed soil to blend the next section. It is anticipated that the soil volume would expand approximately 20 percent due to the fixation process. This additional volume would be used to achieve the needed slope for the cap. An RCRA soil/clay cap placed over the solidified material is necessary to prevent infiltration and additional hydraulic stress on the fixed soil. It is estimated that the fixation would reduce lead migration by 40 percent and that the fixed soil would pass the EPTox levels for lead.

Criteria Assessment

This alternative would protect human health and the environment. This alternative protects against direct contact with contaminated soil and further ground water degradation by treating part of the soil and fixing and capping the remaining soil. It protects against ingestion of contaminated ground water by collecting and treating the affected aquifer to health-based levels.

This alternative meets the MCL for TCE and action-specific ARARs such as air and water discharge limits. As with Alternative 3, the land disposal restrictions are not an ARAR for this alternative since placement does not occur. The cap would meet State RCRA requirements for landfill closure.

The long-term effectiveness of this alternative would be enhanced by the application of treatment technologies that reduce the inherent hazards posed by the sources; all of the contaminated soil would be treated or immobilized by fixation and the contaminated ground water would also be extracted and treated. Even in the unlikely event of cap failure in Area 1, the fixed soil would pose little if any risk of ground water contamination. The potential for cap failure would be minimized through the maintenance program. This alternative would also require a 5-year review.

Soil vapor extraction and air stripping with gaseous carbon adsorption are irreversible. Soil fixation would reduce the mobility of lead by about 40 percent but

would increase the volume of contaminated soil from 25,000 cy to about 30,000 cy. Although this technology is not completely irreversible, the possibility exists that the contaminants could regain some mobility should the cap fail. However, the risk would be small. The residual soil remaining following treatment would not pose a risk to human health or the environment. This alternative satisfies the statutory preference for using treatment as a principal element since it addresses principal threats posed by the site through treatment.

During the vapor extraction process, the contaminated soil would be uncovered and the potential exists for contaminant release into the air (although the risk would be small due to the control system that would be used). In situ soil fixation would release some particulate matter into the atmosphere. However, the fixation process would require only a few months for implementation, lessening the likelihood of any potential risk. Dust control methods would be used to limit the release of particulate matter.

Implementability information for the soil vapor extraction system, the cap, and the ground water pump and treat systems to be used for this evaluation, is provided under Alternative 3. As for the additional fixation process, vendors needed to fix the soil are readily available. The necessary reagents are available within 50 miles of the site. All of the components could be expanded if additional contamination was discovered.

The 30-year present worth cost of this alternative is estimated to be \$10,200,000. The primary cost items are the cap, the ground water treatment system, and the soil fixation of Area 2. The capital cost is estimated to be \$6,200,000, with an annual O&M cost of \$480,000 for the first 5 years. After year 5, the O&M costs would decrease to \$200,000 for ground water treatment and monitoring.

Alternative 5 - Incineration, In Situ Soil Fixation, Ground Water Pump and Treat

This alternative contains components of Alternatives 3 and 4 but introduces a thermal destruction component to address the TCE-contaminated soil. The lead-contaminated soil in Area 1 would be fixed and covered with a soil/clay cap, as described in Alternative 4. The ground water would be addressed through pumping and treating, via an air stripper, as described in Alternatives 3 and 4. The TCE-contaminated soil in Area 2 would be excavated and treated onsite by a thermal destruction unit.

For the purposes of this analysis, the thermal destruction unit is assumed to be a rotary kiln unit. The specific type of incineration would be determined in the Remedial Design phase after competitive

bidding has taken place. The incinerator would be mobilized, operated, and closed according to the specific requirements found in RCRA, Subpart O (40 CFR 264.340). The substantive requirements of the permitting process, though not applicable because the action does not involve RCRA-regulated hazardous waste, have been determined to be relevant and appropriate. A discussion of the ARARs associated with the remediation of Area 1 and the ground water can be found under Alternative 4.

It is estimated that approximately 20,000 cy of contaminated soil would need to be excavated and treated. The risk from the remaining soil would not exceed 1×10^{-6} excess cancer risk level as soil containing TCE at concentrations greater than 56 ppm would be excavated. There are still some uncertainties with this volume estimate so it would be necessary to sample during excavation to determine when sufficient material has been removed.

Incineration of soils contaminated with organic compounds is a proven technology. Conservative estimates about the organic and moisture contents were made to develop the incineration component. The incinerator would be operated continuously (24 hours/day, 365 days/year) in order to reduce the thermal stress on the refractory, although some down time would be required (20 percent) for regular maintenance. Due to the need to maintain continuous operation, a waste pile for the purpose of temporary storage would be constructed in accordance with the relevant and appropriate requirements of RCRA (40 CFR 264.251) which requires a liner and leachate collection system. This storage would ensure operation during periods of poor weather when excavation may not be possible.

The incinerator would operate at a feed rate of 3.5 tons/hr. At this feed rate and assuming that about 20,000 cy of material would be excavated, more than 1 year would be required for incineration. About 30 gallons/hr of fuel oil would be required to run the incinerator. It is assumed that the incinerator would be operated to achieve 99.8 percent TCE removal from the soil and a destruction efficiency as required by RCRA. Specific operating practices to meet the performance objectives, including 99.99 percent destruction of stack emissions as dictated by Subpart O of RCRA, would be determined through a trial burn at the site after installation of the incinerator. Other performance standards include hydrogen chloride emissions not to exceed 1.8 kg/hr and particulate matter emissions of less than 0.08 grains per day standard cubic foot.

The facility would use a dry scrubber system for emission control, which would almost eliminate the need for wastewater treatment. Any water from emission control and from decontamination procedures would be treated in the onsite ground

water treatment system. The residual soil and collected ash is assumed to be nonhazardous and can be disposed of in a solid waste disposal facility in compliance with Subtitle D of RCRA. In the event that they cannot be delisted due to the presence of metals, either residuals will be managed as part of the closure of Area 2 (lead-contaminated soil).

Criteria Assessment

This alternative would be protective of human health and the environment. The contaminated ground water would be collected and treated, reducing further the threat of ingesting contaminated ground water. The risk from ingesting ground water would be lowered to less than 1×10^{-6} . The direct contact risk would be reduced by fixing soil exceeding 200 µg/kg lead and incinerating TCE-contaminated soil with an excess cancer risk level greater than 1×10^{-6} .

Although this alternative would involve the excavation and placement of waste, thus making the land disposal restrictions a potential ARAR, TCE-contaminated soil at this site is not an RCRA hazardous waste and therefore these requirements would not be applicable. The U.S. EPA is undertaking an LDR rulemaking that will specifically apply to soil and debris. Until that rulemaking is completed, the CERCLA program will not consider the land disposal restrictions to be relevant and appropriate to soil and debris that does not contain RCRA-restricted wastes.

The long-term effectiveness of this alternative is enhanced by the destruction of about half of the contaminated soil by thermal destruction and reduction in the mobility of contaminants in the other half through fixation. The ground water pump and treat component is also effective but would require long-term management or monitoring and maintenance. The area where soil is removed for incineration would not require long-term monitoring whereas the contaminated soil that is fixed would remain under a cap and would require long-term monitoring and maintenance. This alternative could be enhanced to effectively control greater areas of contamination or different contaminants (i.e., possible metals in Area 2). Because the fixed soil will remain onsite, this alternative would require a 5-year review.

This alternative reduces the toxicity, mobility, and volume of soil contaminants by incineration. Incineration would destroy an estimated 99.8 percent of the hazardous constituents present in the soil of Area 2, based on previous experience with this technology at other sites. Approximately 18,000 cy of treated soil that would pose minimal risk to human health or the environment would be disposed offsite in the local municipal landfill. Approximately 30,000 cy of soil in Area 1 would remain although the mobility of the lead would be reduced by approximately 40 percent through fixation. Virtually no risk from this soil

would exist as long as the cap is properly maintained to control exposure. Ninety-six percent of the contaminants in the ground water would be removed and eventually destroyed as discussed under Alternatives 3 and 4. This alternative meets the statutory preference for using treatment as a principal element since it addresses the principal threats posed by the site through treatment.

Fixation would require approximately 6 months to complete and would potentially release particulate matter into the air. Excavation and incineration would require approximately a year and may release volatiles into the air. The minor risks from both situations to both workers and the community would be temporary. Air monitoring and foam covers would be used to further minimize the likelihood of risk. The additional risk to workers through operating an incinerator (because of the complexity of the equipment and the high operational temperatures) would be mitigated through the proper use of safety protocols, proper drainage controls, and restrictions on access to contaminated areas. Although emissions from the incinerator would comply with all air quality regulations, potential accidental releases could temporarily affect air quality in the vicinity of the site.

This alternative is inherently difficult to implement due to the incineration component. Operation of an incinerator is mechanically complex and has stringent monitoring requirements to provide proper performance. Consequently, the incinerator and associated facilities require highly trained staff and a substantial amount of attention. In addition, it may be necessary to postpone the implementation until an available mobile incinerator can be found. If metal concentrations in the soil are very high, incineration would not be used and the soil would be fixed along with the soil in Area 1.

It has been estimated that the present worth cost for this alternative would be \$16,000,000, primarily because of the incineration component. The capital cost would be \$13,000,000 and the first year annual O&M is estimated at \$1,200,000 with most of the cost as a result of operating the incinerator. Subsequent year O&M costs would be about \$200,000 since only the ground water treatment and monitoring systems would be operating.

Table F-1 summarizes the above discussion.

Comparative Analysis

In the following analysis, the alternatives are evaluated in relation to one another for each of the evaluation criteria.*The purpose of this analysis is to

*State and community acceptance will be addressed in the ROD following comments on the RI/FS report and the proposed plan.

identify the relative advantages and disadvantages of each alternative.

Overall Protection of Human Health and the Environment

All of the alternatives, except Alternative 1 (no action), provide adequate protection of human health and the environment. Risk through direct contact and ground water ingestion are reduced to cancer risk levels less than 1×10^{-6} through each pathway. Alternatives 3, 4, and 5 prevent further migration of the contaminated ground water by extracting and treating the plume to health-based ARAR levels.

Alternative 2 achieves protection by preventing exposure through capping and natural attenuation of the contaminated ground water. Alternative 3 combines treatment to reduce the risk from the TCE-contaminated soil and ground water and capping of the lead area. Alternatives 4 and 5 reduce risks posed by all portions of the site through treatment.

There is some uncertainty about the potential presence of metals in the TCE-contaminated soil of Area 2. If metal concentrations of concern are present, only Alternatives 2 and 5 would protect against direct contact and further ground-water contamination through a cap and incineration, respectively. Incineration of metal-contaminated soil may result in a hazardous waste residue which would have to be disposed of in a hazardous waste landfill. Alternatives 3 and 4 rely on vapor extraction to remedy the soil in Area 2. Soil vapor extraction would not lower risks from metals to human health or the environment.

Compliance with ARARs

The evaluation of the ability of the alternatives to comply with ARARs included a review of chemical-specific and action-specific ARARs that was presented earlier in the report. There are no known location-specific ARARs for this site. All alternatives will meet all of their respective ARARs except the no-action alternative.

Long-Term Effectiveness and Permanence

Alternatives 4 and 5 afford the highest degrees of long-term effectiveness and permanence because both alternatives use treatment or fixation technologies to reduce hazards posed by all known wastes at the site. While some contaminated soil would remain after implementation of both alternatives, it would be fixed to reduce mobility. These two alternatives differ only in the technology used to treat the TCE-laden soil. Although incineration would destroy more TCE than soil vapor

extraction, both alternatives reduce risks posed by the waste to a 1×10^{-6} cancer risk levels through both the ground water and soil pathways.

Alternatives 4 and 5 would rely on a soil/clay cap to control infiltration, a reliable technology if properly maintained. In addition, Alternative 5 would also employ a solid waste landfill to manage the residue from incineration. Upon completion, some long-term maintenance of the cap and ground water monitoring would be required for both alternatives until the alternative has met the health-based cleanup goals for ground water, at which point the monitoring can be discontinued. These alternatives would have almost no long-term reliance on institutional controls.

Alternative 3 eliminates the risk of exposure at the site to the same levels as Alternatives 4 and 5 in the short-term; however, it relies solely upon a cap for controlling the waste remaining in Area 1. Although capping is an effective and accepted approach for reducing risk from direct contact with wastes, it is less reliable in the long-term than treatment to remove or fix contaminants in soil since the inherent hazard of the lead would remain. Since a potential for cap failure, however small, would exist, the long-term effectiveness of Alternative 3 would not be as reliable as Alternatives 4 and 5. Long-term management requirements for Alternative 3 are similar as those of Alternative 4 or 5; operation of the ground water pump and treat systems would be required for 25 to 40 years. However, the capped area under Alternative 3 is greater in size than the capped areas under Alternatives 4 and 5.

Alternative 2 leaves all of the contaminated waste at the site and relies solely upon a cap and institutional controls to prevent exposure. Although the alternate water supply lowers the risk of ingesting contaminated ground water from existing wells, the local municipality estimates that the existing regulations to be used as institutional controls would not be effective with a high degree of certainty for more than 5 to 10 years in preventing the installation of new wells and the ingestion of contaminated ground water.

Alternative 2 also has long-term ground water monitoring and cap maintenance requirements (mowing, revegetation, cap repair) which are more critical for the effectiveness of this alternative since all of the waste (without any type of treatment to reduce their mobility, toxicity, or volume) remains at the site under the caps. Failure to detect a problem with the cap may result in direct contact with the contaminated soil and further degradation of the ground water through leachate production. Monitoring will continue until the health-based cleanup goals are met. A 5-

year review would be necessary to verify that the remedy remains protective.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 4 and 5 use treatment or fixation technologies to reduce the inherent hazards posed by all known waste at the site. Both of these alternatives would either treat, fix, or excavate and incinerate all soil posing more than a 1×10^{-6} excess cancer risk level by ingestion. Both alternatives treat the ground water and then treat the contaminated air stream from the air stripper with GAC. Regeneration of the GAC ultimately destroys the ICE. The soil vapor extraction system also contains GAC gaseous treatment. Both alternatives also fix the soil contaminated with lead, reducing the mobility of the lead by an estimated 40 percent. Neither alternative completely treats all of the soil at the site. Both alternatives produce 30,000 cy of fixed soil, and 18,000 to 20,000 cy of treated soil. Under Alternative 5, 18,000 cy of soil (with 99.8 percent of the TCE destroyed) would remain. Under Alternative 4, 20,000 cy of soil (with 99.9 percent of the TCE removed and ultimately destroyed) would remain. These two alternatives would satisfy the statutory preference for treatment as a principal element.

Alternative 3 treats the principal threats posed by the soil and the ground water and thus also satisfies the statutory preference for treatment as a principal element. Approximately 25,000 cy of lead-contaminated soil would remain untreated onsite. However, the mobility of this lead is very low. Alternative 3 reduces the toxicity of 20,000 cy of TCE-contaminated soil by using soil vapor extraction at Area 1. Alternative 3 also reduces the volume and toxicity of contaminated ground water.

Alternative 2 uses no treatment technologies. All of the contaminated soil, controlled by a cap, and all of the contaminated ground water would remain, although the contaminants in the groundwater will naturally attenuate.

Short-Term Effectiveness

Alternative 2 is anticipated to have the greatest short-term effectiveness. Alternative 2 presents the least amount of risk to workers, the community, and the environment. Some particulate emissions from cap installation is anticipated during implementation; however, dust control methods should reduce this risk. The other alternatives could release volatiles during excavation activities or soil vapor extraction. These emissions may be more difficult to control.

The time required to achieve short-term protection would be shorter than for any other alternative. It is anticipated that only 6 months would be required to

Table F-1
INDIVIDUAL EVALUATION OF FINAL ALTERNATIVES
CASE STUDY

Criteria	Alternative 1 No Action	Alternative 2 Cap, Natural Attenuation	Alternative 3 In-situ Soil Vapor Ex- traction, Cap, Ground- water Pump and Treat	Alternative 4 In-situ Soil Vapor Ex- traction, In-situ Soil Fixation, Cap, Ground- water Pump and Treat	Alternative 5 In-situ Soil Fixation, Cap, Incineration, Ground- water Pump and Treat
OVERALL PROTECTIVENESS					
Human Health Protection					
- Direct Contact/ Soil Ingestion	No significant reduc- tion in risk. Some re- duction in access to risk through fence.	Cap reduces direct con- tact risk and soil in- gestion risk to less than 1×10^{-6} .	Cap and vapor extraction reduce direct contact/ soil ingestion risk to less than 1×10^{-6} .	Cap, fixation, vapor extraction reduce direct contact/soil ingestion risk to less than 1×10^{-6} .	Cap, fixation, incinera- tion reduce direct con- tact/soil ingestion risk to less than 1×10^{-6} .
- Ground-water Ingestion for Existing Users	No reduction in risk.	Protects against exist- ing risk by providing an alternate water supply.	Reduces risk to less than 1×10^{-6} by pump and treat.	See Alternative 3.	See Alternative 3.
- Ground-water Ingestion for Future Users	No reduction in risk.	Institutional controls provide protection against risk from ground-water ingestion.	Reduces risk to less than 1×10^{-6} by pump and treat.	See Alternative 3.	See Alternative 3.
Environmental Protection					
	Allows continued con- tamination of the ground water.	Continued contamination is curtailed by use of cap. Continued migra- tion of contaminated groundwater is allowed.	Continued contamination is curtailed by soil vapor extraction and by cap. Migration of con- taminated ground water is curtailed by pump and treat.	Continued contamination is curtailed by soil vapor extraction, soil fixation, and cap. Migration of contami- nated ground water is curtailed by pump and treat.	Continued contamination is curtailed by soil fixation and incinera- tion. Migration of con- taminated groundwater is curtailed by pump and treat.
COMPLIANCE WITH ARARs					
Chemical-Specific ARARs	Does not meet ground- water standards past the site boundary.	Would meet MCLs at the waste boundary in over 50 years.	Would meet MCLs at the waste boundary in 25-40 years.	See Alternative 3.	See Alternative 3.
Location-Specific ARARs	Not relevant. There are no location- specific ARARs.	See Alternative 1.	See Alternative 3.	See Alternative 1.	See Alternative 1.
Action-Specific ARARs	Would not meet any ARARs since there will be no action.	Will meet RCRA land- fill closure requirements.	Would meet RCRA land- fill closure require- ments. Would also meet air release standards from the vapor extraction system. Would meet NPDES requirements.	Would meet air release standards from air strip- pers and vapor extraction system. Would meet NPDES requirements. Would meet RCRA landfill closure requirements.	Would meet regulations concerning incineration and air stripping. Would meet NPDES requirements. Would meet RCRA landfill closure requirements.
Other Criteria and Guidance	Would allow ingestion of ground water exceed- ing 1×10^{-6} . Would not protect against Pb levels above 200 ug/kg in soil.	Protects against soil ingestion to 1×10^{-6} level and ground-water ingestion at 1×10^{-6} level. Covers soil with Pb above 200 ug/kg.	See Alternative 2.	See Alternative 2.	See Alternative 2.

Table F-1 (Continued)

Criteria	Alternative 1 No Action	Alternative 2 Cap, Natural Attenuation	Alternative 3 In-situ Soil Vapor Ex- traction, Cap, Ground- water Pump and Treat	Alternative 4 In-situ Soil Vapor Ex- traction, In-situ Soil Fixation, Cap, Ground- water Pump and Treat	Alternative 5 In-situ Soil Fixation, Cap, Incineration, Ground- water Pump and Treat
LONG-TERM EFFECTIVENESS AND PERSISTENCE					
Magnitude of Residual Risk					
- Direct Contact/ Soil Ingestion	Source has not been removed. Existing risk will remain.	Risk eliminated as long as cap is maintained. Because source is only contained, inherent hazard of waste remains.	Risk eliminated through vapor extraction and cap. Some inherent hazard remains in the lead material under the cap. Risk from lead would only occur if the cap were destroyed.	Slight chance of future risk from fixed lead-contaminated soil.	See Alternative 4.
- Ground-water Ingestion for Existing Users	Future risk greater as plume migrates to residents. Eventually natural attenuation and dilution may decrease risk. Risk significant for about 100 years.	Risk eliminated by providing alternate water supply. Some risk would remain for over 100 years if the ground water is used.	Risk eliminated by extracting ground water exceeding 10 ⁻⁶ cancer risk levels. Safe drinking water achieved in 25-40 years with source control.	See Alternative 3.	See Alternative 3.
- Ground-water Ingestion for Future Users	Risk greater as area of contamination increases. Eventually natural attenuation and dilution may decrease risk. Risk significant for about 100 years.	Institutional controls used to control use of contaminated ground water. Unauthorized use of ground water would result in increased risk.	Risk eliminated by extracting ground water exceeding 10 ⁻⁶ cancer risk levels. Safe drinking water achieved in 25-40 years with source control.	See Alternative 3.	See Alternative 3.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Risk to ground water controlled by alternate water supply and institutional controls. Soil/clay cap controls contaminated soil. Cap effective for Area 2 even if metals are present. Institutional controls are limited in effectiveness.	Soil/clay cap controls remaining contaminated soil in Area 1. Would need additional controls for Area 2 if metals are present since soil vapor extraction would not remove metals. Groundwater extraction controls contaminated groundwater. Both are adequate.	See Alternative 3.	Similar to Alternative 3. Incinerator ash disposed in municipal landfill. If metals are present in Area 2, incinerator ash would be disposed in ACRA landfill.
		Reliability of cap can be high if maintained. Institutional controls to control use of ground water not very reliable.	Reliability of vapor extraction high because no long-term O&M is required. Cap reliable if maintained. Ground-water pump and treat is reliable.	Reliability of fixation with cap high, as are vapor extraction and ground-water pump and treat.	Incineration very reliable because material is destroyed. Fixation with cap and ground-water pump and treat are reliable.
Need for 5-Year Review	Review would be required to ensure adequate protection of human health and the environment is maintained.	See Alternative 1. TCE and lead soil would remain onsite.	See Alternative 1. Lead-contaminated soil would remain onsite.	See Alternative 1. Fixed lead residuals would remain onsite.	See Alternative 1. Fixed lead residuals would remain onsite.

Table F-1 (Continued)

Criteria	Alternative 1 No Action	Alternative 2 Cap, Natural Attenuation	Alternative 3 In-situ Soil Vapor Ex- traction, Cap, Ground- water Pump and Treat	Alternative 4 In-situ Soil Vapor Ex- traction, In-situ Soil Fixation, Cap, Ground- water Pump and Treat	Alternative 5 In-situ Soil Fixation, Cap, Incineration, Ground- water Pump and Treat
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Treatment Process Used	None.	None.	Vapor extraction of soil and groundwater air stripping.	Vapor extraction, soil fixation, and groundwater air stripping.	Incineration, soil fixation, and groundwater air stripping.
Amount Destroyed or Treated	None.	None.	99.9% of volatiles in soil and 96% volatiles in groundwater removed and destroyed by carbon regeneration.	Same as Alternative 3 plus 25,000 cy of contaminated soil is fixed.	99.8% of volatiles in 20,000 cy of soil destroyed and 25,000 cy of contaminated soil is fixed.
Reduction of Toxicity, Mobility, or Volume	None.	None.	Reduced volume and toxicity of contaminated groundwater. Toxicity of soil contamination reduced.	Reduced volume and toxicity of contaminated groundwater. Toxicity of soil contamination in Area 2 reduced 97%. Mobility of contaminants in Area 1 reduced 10% while volume increased 20%.	Incineration reduces volume of contaminated soil by 20,000 cy and reduces toxicity. Mobility of contaminants in Area 1 is reduced. Volume and toxicity of contaminated groundwater is reduced.
Irreversible Treatment	None.	None.	Vapor extraction and air stripping are irreversible with regeneration of carbon used for air stream treatment.	See Alternative 3.	Incineration is irreversible. Air stripping with subsequent gaseous carbon treatment and regeneration is irreversible.
Type and Quantity of Residuals Remaining After Treatment	No residuals remain.	None.	No detectable residuals in Area 2 remain. Carbon from gaseous treatment requires regeneration.	No detectable residuals in Area 2 remain. 30,000 cy of fixed soils remain in Area 1.	Incinerated soil (18,000 cy) and fixed soils (30,000 cy) remain. Incinerated soil expected to be nonhazardous. Carbon from gaseous treatment remains, requiring regeneration.
Statutory Preference For Treatment	Does not satisfy.	Does not satisfy.	Satisfies.	Satisfies.	Satisfies.
SHORT-TERM EFFECTIVENESS					
Community Protection	Risk to community not increased by remedy implementation, but, contaminated water may reach the residents within 1-3 years.	Temporary increase in dust production through cap installation. Contaminated soils remain undisturbed.	Soil would remain uncovered during vapor extraction for 3-5 years. Temporary increase in dust production during cap installation.	Similar to Alternative 3. Fixation may result in dust and odor increase.	Soil would remain uncovered during incineration (about 1 year). Excavation and fixation would release dust and odors to the atmosphere.
Worker Protection	No significant risk to workers.	Protection required against dermal contact and inhalation of contaminated dust during cap construction.	Protection required against dermal contact, vapor or dust inhalation during construction and operation of vapor extraction system and air stripper.	Protection required against dermal contact, vapor, or dust inhalation during construction and operation of vapor extraction system, fixation, and air stripper.	Protection required against dermal contact and inhalation of volatiles and particulates as a result of excavation, fixing, and incinerating TCE soil.

Table F-1 (Continued)

Criteria	Alternative 1 No Action	Alternative 2 Cap, Natural Attenuation	Alternative 3 In-situ Soil Vapor Ex- traction, Cap, Ground- water Pump and Treat	Alternative 4 In-situ Soil Vapor Ex- traction, In-situ Soil Fixation, Cap, Ground- water Pump and Treat	Alternative 5 In-situ Soil Fixation, Cap, Incineration, Ground- water Pump and Treat
SHORT-TERM EFFECTIVENESS (Cont'd)					
Environmental Impacts	Continued impact from existing conditions.	Would be some migration of contaminant plume as part of attenuation process.	Vapor extraction may impact air quality and odors although it will meet emission standards. Would be aquifer draw-down during ground-water extraction.	See Alternative 3. Fixation may also affect air quality and produce odors.	Incineration may impact air quality, produce odors, although it will meet emission standards.
Time Until Action is Complete	Not applicable	Cap installed in 6 months. Risk from ground water reduced within 3 months due to alternate water supply and institutional controls.	Soil vapor extraction complete in 3-5 years. Capping complete in 6 months. Ground-water remedial action complete in 25-40 years.	Fixation and capping completed in 9 months. Soil vapor extraction complete in 3-5 years. Ground-water action complete in 25-40 years.	Incineration complete in 2 years from design completion. Fixation and capping complete in 9 months. Groundwater action complete in 25-40 years.
IMPLEMENTABILITY					
Ability to Construct and Operate	No construction or operation.	Simple to operate and construct. Would require materials handling of about 50,000 cy of soil and clay.	Vapor extraction requires some operation. Fairly straightforward to construct. Cap construction would require materials handling of 25,000 cy of soil and clay. Onsite ground-water treatment requires operation.	Fixation with cap somewhat difficult to construct. Otherwise similar to Alternative 3.	Incineration is difficult to operate. Fixation with cap is somewhat difficult to construct. Similar to Alternative 3 with respect to ground water.
Ease of Doing More Action if Needed	If monitoring indicates more action is necessary, may need to go through the FS/ROD process again.	Simple to extend extraction system and cap. Cap would be sufficient if metals were significant in Area 2. Could implement ground-water treatment if necessary.	Simple to extend ground-water extraction system, vapor extraction system, and cap. However, if significant metal concentrations are present in Area 2, may need additional soil treatment or would need to extend cap.	Fairly complete alternative. Can increase volume of or modify all technologies. If significant metal concentrations are present in Area 2, could use fixation.	Complete alternative. Can handle varying volumes or concentrations.
Ability to Monitor Effectiveness	No monitoring. Failure to detect contamination means ingestion of contaminated ground water.	Proposed monitoring will give notice of failure before significant exposure occurs.	See Alternative 2.	See Alternative 2.	See Alternative 2.

Table F-1 (Continued)

Criteria	Alternative 1 No Action	Alternative 2 Cap, Natural Attenuation	Alternative 3 In-situ Soil Vapor Ex- traction, Cap, Ground- water Pump and Treat	Alternative 4 In-situ Soil Vapor Ex- traction, In-situ Soil Fixation, Cap, Ground- water Pump and Treat	Alternative 5 In-situ Soil Fixation, Cap, Incineration, Ground- water Pump and Treat
IMPLEMENTABILITY (Cont'd)					
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval necessary.	See Alternative 1.	Need an NPDES permit. Should be easy to obtain.	See Alternative 3.	Need to demonstrate technical intent of incinerator permit. Need an NPDES permit.
Availability of Services and Capacities	No services or capacities required.	See Alternative 1.	See Alternative 1.	Need fixation services.	Need fixation and incineration services.
Availability of Equipment, Specialists, and Materials	None required.	No special equipment, material, or specialists required. Cap materials available within 20 miles.	Needs readily available specialists to install and monitor vapor extraction system. Need treatment plant operators. Cap materials available within 20 miles.	See Alternative 3.	Need a mobile incinerator and trained operators. Need treatment plant operators. Closest source of incinerator is 500 miles from site.
Availability of Technologies	None required.	Cap technology readily available.	Vapor extraction well developed. Will require pilot testing.	Vapor extraction and fixation well developed. Will require pilot testing.	Incineration and fixation well developed. Will require pilot testing.
COST					
Capital Cost	\$ 0	\$ 4,200,000	\$ 3,300,000	\$ 6,200,000	\$13,000,000
First Year Annual O&M Cost	0	60,000	440,000	480,000	1,200,000
Present Worth Cost	0	4,800,000	7,300,000	10,200,000	16,000,000

install a new cap and to provide an alternate water supply. Alternatives 3 and 4, involving vapor extraction require 3 to 5 years before the risk from direct soil contact and ingestion is controlled.

Alternatives 3 and 4 are very similar with respect to short-term effectiveness. Implementing the soil vapor extraction system requires the most time of the source control actions. There is a small potential for risk to the community, workers, and the environment through volatile emissions during extraction to the air in the unlikely event of control failure.

Alternative 5 would take longer to implement than Alternative 2 and has a greater potential of releasing volatiles to the atmosphere during excavation than Alternatives 3 and 4. However, implementation of Alternative 5 would take less time than Alternatives 3 and 4 since incineration would require less time than soil vapor extraction to remediate the soil to safe levels. However there may be a possibility of volatile emissions during excavation that would need to be controlled. Alternative 5 has the disadvantage of requiring incineration equipment (the most technically complex equipment of any of the alternatives) which could increase the risk to workers in the event of a failure. Careful implementation of standard safety protocols would lessen this risk.

Implementability

Alternative 2 would be the simplest to construct and operate. While construction of a cap would have significant materials handling requirements, the materials are available locally. Expansion of the cap could incorporate other areas of contamination if discovered during activities at the site, specifically if metals become an issue at Area 2. Periodic maintenance of the cap should control its reliability in the future. The ground water monitoring program would determine the effectiveness of the cap at decreasing future contamination of the ground water. The alternate water supply would reliably supply safe drinking water despite the fractured nature of the aquifer.

Construction requirements for Alternative 3 are fairly simple. Alternative 3 has more operational requirements than Alternatives 1 and 2 because of the soil vapor extraction system and the air stripper. As with the other alternatives, if additional contamination is found at the site, the components could be sized to include the additional areas. However, if metals were found in Area 2, soil vapor extraction would not effectively treat the soil and another technology would need to be used to control the risk from direct contact.

Soil vapor extraction is a fairly reliable technology because of its mechanical simplicity. Very little

downtime is anticipated. However, as with any in situ treatment system, samples throughout the soil (both varying in location and in depth) must be taken frequently to determine the effectiveness of the technology.

Alternative 3 would require readily available engineering services and cap materials. An air stripper could readily be obtained and constructed onsite. All of the treatment technologies proposed for this alternative are proven. However, it would be difficult to evaluate the effectiveness of the ground water extraction system in the fractured aquifer. It would be difficult to determine where to install extraction wells to intercept contamination since the fractures would be difficult to locate. Additional treatability studies for the soil treatment component of this alternative and some fracture trace analysis would help ensure the success of this alternative.

Alternative 4 is more complex than Alternative 3 because of the in situ soil fixation component. While this component has no additional operation requirements, it would require additional construction techniques that would have to be supplied by specialists in this area. Vendors for soil fixation are readily available. Additional treatability work may be required to optimize the reagent doses. Other than the in-situ solidification component, Alternative 4 is similar to Alternative 3 in terms of implementability. However, the solidification component could be easily used on Area 2 if significant metal contamination were found.

Alternative 5 is the most complex alternative to construct and, during implementation, to operate. However, despite anticipated frequent downtime due to mechanical complexity, incineration could reliably meet the cleanup goals. A mobile incinerator would have to be located and brought onsite. During operation of the incinerator, this alternative would require the most attention because incinerators require periodic sampling of the residue and modification of operating parameters. However, the incinerator would operate for slightly more than a year, whereas the soil vapor extraction system of Alternative 4 would operate for 3 to 5 years.

As with Alternatives 3 and 4, some initial treatability work would be necessary to determine operating parameters. Other than locating, constructing, and operating the incinerator, the other implementability aspects of this alternative are similar to Alternatives 3 and 4. Incineration would also not be effective in treating Area 2 soils if metals are determined to be a health risk. The ash would be a hazardous waste under this scenario and would require disposal at an RCRA Subtitle C landfill.

Cost

Alternative 2 has a lower present worth and O&M cost than Alternative 3, but because of the additional cap required, it has a higher capital cost (\$4,200,000 versus \$3,300,000). The cap is one of the most expensive components to construct. Alternative 4 has a higher capital, O&M, and present worth cost than Alternatives 2 and 3. Alternative 5 has the highest capital (\$13,000,000), first year O&M (\$1,200,000), and present worth cost (\$16,000,000) of all of the

alternatives because of the incinerator component. The cost details of all of the alternatives are included in the appendix to this FS report.

State Acceptance

To be addressed in the ROD.

Community Acceptance

To be addressed in the ROD.

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 1, 1861. It is a very important document, as it sets out the President's policy for the new year.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 1, 1861. It contains a detailed account of the financial state of the country.

3. The third part of the document is a report from the Secretary of the Interior, dated January 1, 1861. It contains a detailed account of the state of the interior of the country.

4. The fourth part of the document is a report from the Secretary of the Navy, dated January 1, 1861. It contains a detailed account of the state of the Navy.

Exhibit Q

Fields of Expertise

Geotechnical Engineering, Environmental Engineering, Remedial Design, Construction Management, Hydrogeology, Community Relations and Regulatory Compliance.

Education

Master of Science - Civil Engineering; University of Michigan, 1984

Bachelor of Science - Environmental Science Engineering; University of Michigan, 1983

Professional Registrations

Professional Engineer: AL, CO, DE, IL, MD, MI, NC, NE, NJ, NY, OH, OR, PA, and WY

Present Duties & Responsibilities

Ms. Forslund is a Project Manager coordinating activities on RCRA and CERCLA sites. She is responsible for work quality, budgets and schedules as well as serving as a technical reviewer on other Advanced GeoServices projects.

Experience Summary

Ms. Forslund has been working in the environmental industry since 1984, managing and conducting remedial, hydrogeologic, geotechnical investigations and feasibility studies for the remediation of contaminated sites. Her work has included the management of emergency removal and remediation activities from investigation through design; risk assessment; and construction oversight as well as extensive community relations and regulatory responsibilities.

Remedial Design/Remedial Action Project Experience

Former Lead Smelter in Omaha, Nebraska. *Project Manager.* Prepared comments on EPA's proposed plan for a \$150+ million residential soil removal. Comments discussed deficiencies in EPA's risk assessment and RI/FS and demonstrated that the lead in soil did not originate from the secondary lead smelter. Developed strategy to conduct air depositions modeling based on historical research on sources of air lead to support de minimus claim.

Residential Lead Sites. *Project Manager.* Assisted in Consent Order negotiations, prepared Work Plans, assisted in contractor selection, oversaw removal activities, and managed implementation of the Work Plans at sites in Illinois, Georgia, and Indiana.

Former Brass Foundry in New York. *Project Manager.* Developed a Remedial Action Work Plan and related bid documents and oversaw removal activities at 36 residential properties in the vicinity of a former brass foundry. Developed remedial alternatives to address former lagoons and contaminated soil at the foundry property.

Former Secondary Lead Smelter in Michigan. *Project Manager.* Completed the Remedial Action Work Plan and bid documents for soil removal on approximately 100 residential properties in the vicinity of a former lead smelter. Assisted in the selection of the remedial contractor and managed the implementation of the Work Plan.

Former Rail Yard. *Project Manager.* Assisted in the oversight and coordination for the remediation of a former rail car repair facility that was contaminated with PCBs. Oversaw the construction of an 11,000 s.f. MSE retaining wall.

Battery Recycling Site. *Project Manager.* Directed a CERCLA emergency removal action at an inactive lead-acid battery processing plant and the surrounding community. Project involved excavation and restoration of about 133 residential properties; stabilization of an eroding 170,000 cubic yard battery casing landfill using vegetative covers, surface water diversions, and a sedimentation basin; excavation and restoration of intermittent streams; design and construction of a storm sewer system; building demolition; interior cleaning of residences for removal of lead contaminated housedust; determination of extent of contamination from site operations; and risk assessment for exposure to lead contaminated soils. Responsibilities include overseeing design and construction activities; construction management; field investigations; data analysis; report preparation; community relations; public meetings; coordination of subcontractors;

budgeting and schedules; negotiations with regulatory agencies; client contact; and coordination with client's attorneys and litigation support. Project recognized for design excellence by Pennsylvania's Consulting Engineers Council (1992).

Battery Recycling Site. Project Manager. Directed a RCRA corrective action at an inactive lead-acid battery processing facility. The site contains over 370,000 cubic yards of battery casing and contaminated fill and overlies abandoned surface and deep coal mines. Work includes preparation of work plans; implementation of RFI and CMS; evaluation and selection of alternate corrective measures; remedial design of 10-acre containment area, oversight of construction and contract management for \$11 million contract, community relations, budgeting, schedules, and negotiations with federal and state regulatory agencies.

Former Lead Smelter in Portland, Oregon. Project Manager. Prepared work plans, design documents and technical specifications for the dredging and backfilling of a lake and the construction of an on-site containment facility for the disposal of 65,000 cubic yards of contaminated soils and sediments and stabilized battery casing materials.

Manufacturing Facility in Caldwell, Ohio Project Manager. Directed the preparation of the Feasibility Study to address contaminated groundwater, soils, and wetlands and a waste disposal area located within a flood plain. Developed the technical strategy to successfully challenge the selected remedy to reduce the future cleanup costs. Managed remedial design process, contractor selection, construction oversight and contract management for \$2.5 million contract to excavate, consolidate and cap contaminated soils and sediments and install a groundwater extraction and treatment system.

Interior Cleaning Program. Project Manager. Directed a CERCLA emergency removal action for lead contamination in a community adjacent to a former zinc smelter. Interior housedust removal was performed in twelve homes; in addition, extensive dust, soil, water and lead paint sampling was performed for purposes of exposure assessment and to evaluate the effectiveness of cleaning activities. Work included development of the Removal Action Plan, bid documents, contractor selection, oversight of removal activities, sampling, data evaluation and report preparation.

Former Copper Smelter. Principal and Technical Reviewer. Worked on a community soils RI/FS at an NPL smelter site. Work included statistical analysis of arsenic soil data; report preparation; negotiations with EPA and public meetings.

Active Secondary Lead Smelter/Battery Manufacturing Facility. Project Manager/Technical Reviewer. Sampled an adjacent residential area and conducted an on-site groundwater investigation for RCRA facility investigation.

Closure of Surface Impoundments. Project Engineer. Performed an in-place, RCRA closure of four surface impoundments containing over 1 million cubic yards of electroplating sludges and other wastes. Work included investigation of impoundments and surrounding area to determine volume of wastes, bottom configuration, piezometric levels, geotechnical characteristics of soils, and contaminant migration; review and selection of closure alternatives; bench scale evaluation of stabilized sludges for contractor evaluation; conceptual design and closure plan; and cost estimates for closure and negotiations with state and federal regulatory agencies.

Strategic Support Services Project Experience

Due Diligence at a Former Steel Manufacturing Site. Project Manager. Assisted the client in evaluating environmental conditions on a 30-acre parcel within a former steel manufacturing site. Assessed geotechnical conditions and other development-related components to the project.

Residential Lead Investigations. Project Manager. Performed three investigations into the presence of lead within residences including housedust soil and tap water sampling and lead based paint screening. The projects were located in Texas, Pennsylvania and Idaho.

Human Health and Ecological Risk Assessment at a Manufacturing Site in Ohio. Project Manager. Considered the site contaminants, which included TCE in groundwater and lead-bearing wastes in an on-site disposal area. Risks to workers, future residents and ecological receptors in the adjacent creek and wetlands were considered.

Defense Support in Cost Recovery Action. Consultant. Assisted client in settlement discussions in a cost recovery claim for the remediation of a former lead-acid battery manufacturing plant. Reviewed the project data and developed cost basis for negotiations.

Community Task Force. Consultant. Acted as a consultant to a community task force at an NPL smelter site. The task force included community members and representatives of the PRPs and EPA. Work included coordination and management of a lead exposure study and reduction program; and coordination of task force participation in an EPA risk assessment.

Litigation Support on Lead Contamination Cases. Expert Witness. Provided expert, fact witness support for several cases involving lead contamination on industrial sites and in residential areas. Services have included data management, expert testimony, sampling, data analysis and preparation of graphics for courtroom use. The cases have involved sites in Pennsylvania, Michigan, Georgia and Texas.

Landfill and Surface Impoundment Services Project Experience

Geotechnical Evaluation of Liner System for a Hazardous Waste Landfill. Staff Engineer. Performed geotechnical evaluations of a multi-layer clay/geosynthetic liner system for two hazardous waste landfills. Performed extensive calculations at various slope geometries, laboratory and field investigation of soil strength characteristics at different moisture contents and compaction efforts, and construction and controlled failure of a test fill and construction monitoring.

Other work on landfills includes cover design, closure plans, hydrogeologic investigations and construction quality control.

Publications

"Results of a Soil Lead Study Conducted in a Residential Area," by J.R. Taylor and B.L. Forslund.

"Source Attribution of Elevated Residential Soil Lead Near a Battery Recycling Site," by M. J. Small, A.B. Nunn, III, B.L. Forslund and D.A. Daily. Environmental Science and Technology, April, 1995.

"Comparison of UPBK Model Predictions and Actual Blood Lead Values at a Former Battery Recycling Site," by T.A. Lewandoski (primary author) and B.L. Forslund. Environmental Geochemistry & Health. December 1994.

"Environmental Impacts on Blood Lead Levels in the Vicinity of a Former Battery Recycling Plant," by J.R. Taylor (primary author) and B.L. Forslund. Proceedings of the 25th Annual Conference on Trace Substances in Environmental Health. 1991.

"Artificial Recharge of Stormwater Runoff from a Shopping Center," by B.L. Forslund (primary author) and D.A. Daily. Proceedings of the Cluster of Conference, Ground Water Management and Wellhead Protection; NWWA. 1990.

"The Use of Electromagnetic Techniques in Site Assessments," by K.H. Earley (primary author) and B.L. Forslund. Presented at the Association of Engineering Geologists Annual Meeting. 1989.

"Physical Testing Program for a Stabilized Metal Hydroxide Sludge," by L.J. Shekter Smith, W.R. Bergstrom, and B.L. Forslund. STP 1033 Environmental Aspects of Stabilization and Solidification of Hazardous and Radioactive Wastes: American Society for Testing and Materials Special Technical Publication. 1989.

"Test Fill for Double Liner System," by L.J. Shekter Smith, M.A. Young, and B.L. Forslund. Proceedings of the ASCE Specialty Conference on Geotechnical Practice for Waste Disposal. June 1987.

Continuing Education

- National Safety Council Emergency Care Adult CPR Course, 2011
- 8-Hour OSHA Training Refresher, 2010
- Geosynthetics in Infrastructure Enhancement, December 1995
- Hazardous Waste Site Manager/Supervisor, 1988
- 40-Hour OSHA Health and Safety Training, April 1987
- Nuclear Density Gauge Training, March 1987

Professional Affiliations

- American Society of Civil Engineers
- Society for Environmental Geochemistry & Health, Executive Board

Fields of Expertise

Strategic Environmental Liability Management, Civil Engineering, Environmental Engineering, Geotechnical Engineering, Landfill Design, Geologic and Hydrogeological Investigations, Construction Management and Environmental and Facility Audits, Quality Assurance/Quality Control

Education

Bachelor of Science - Mining Engineering; Pennsylvania State University, 1984

Master of Science - Civil Engineering; Drexel University, 1991

Professional Registrations

Professional Engineer: PA, OH, GA, IL, IN, NC

Present Duties & Responsibilities and Experience Summary

Mr. Reitman is responsible for all facets of project management and technical evaluation. His activities include developing project management strategies, client contact, task assignments, quality control, budget and schedule control, invoicing, performing and reviewing engineering calculations, and report writing. Mr. Reitman is a Project Consultant with experience in applied Environmental, Civil, and Geotechnical Engineering. Most of this experience is on active and inactive industrial sites and contaminated residential properties. Mr. Reitman's experience in the environmental field includes investigating, designing, constructing, and closing of hazardous waste landfills, surface impoundments, and on-site remediations of soil and groundwater. Mr. Reitman has also overseen removal activities and is familiar with regulations for chemical and waste management and has completed or managed audits on over 15 facilities. Mr. Reitman has used his multi-disciplinary background to balance remedial options.

Metals Project Experience

Major Battery Lead Landfill in Northeast PA. Senior Engineer. Assisted with completion of a RCRA facility investigation and Corrective Measures Study of a site with over 400,000 cubic yards of battery casings and lead-impacted soils. Oversaw all project field activities on this multi-year project, which includes consolidation and capping of on-site materials.

Jack's Creek Superfund Site in Central, PA. Senior Engineer/Project Manager. Oversaw all pre-design, design, construction oversight and monitoring activities on this former recycling site with over 250,000 cubic yards of soils and debris. Remedial activities included building demolition, soil stabilization, soil consolidation, and capping.

Major Lead Recycler in Eastern PA. Senior Engineer/Project Manager. Completed a RCRA Part B permit renewal.

Major Lead Recycler in Southeast NY. Senior Engineer/Project Manager. Completed a field investigation and managed the design of a landfill cell and cap which was designed to hold up to 200,000 cubic yards of waste material.

Metals Landfill in Southeastern PA. Senior Engineer/Project Manager. Designed and oversaw construction of a cap placed over 150,000 cubic yards of contaminated metals material.

Strategic Support Services Project Experience

Brownfields Activities. Project Manager. Oversaw the brownfield investigation and redevelopment activities in New York, Pennsylvania, North Carolina, New Jersey and Ohio.

Feasibility for a Superfund Site. Project Manager. Developed a feasibility study for a large Superfund site contaminated with PCBs. The cost and implementability of capping, solidification/ stabilization, off-site disposal, thermal separation, solvent extraction, incineration and dechlorination treatment options were evaluated.

Remediation Oversight. Project Manager. Tracked budget for a \$100,000,000 remediation project to determine compliance with an insurance policy. Identified budget variances and rationale for variances and recommended follow up actions.

Remedial Options to Remove TCE in Groundwater. Project Manager. Performed economic and technical analysis for remedial options to remove TCE in groundwater.

Soil and Groundwater Contaminated with Dissolved Phase VOCs and Free Phase DNAPLs. Project Manager. Evaluated soil and groundwater clean up alternatives and provided estimated remediation costs for sites with soil and groundwater contaminated with dissolved phase volatile organic compounds and free phase Dense Non-Aqueous Phase Liquids (DNAPL).

Act 2 Closure. Project Manager. Developed an Act 2 closure plans for sites with significant metals and organic contamination in soil and groundwater.

Feasibility Analysis. Project Manager. Coordinated an evaluation of the feasibility of using rail transportation to remove several hundred thousand cubic yards of solidified material from a large landfill being remediated under the RCRA Corrective Measures process.

Groundwater Remedial Design/Remedial Action. Project Manager. Completed a remedial design for a 150 gallon per minute groundwater extraction and treatment system. Oversaw construction of this site.

Risk-Based Analysis. Project Manager. Utilized a risk-based rationale to justify the impracticability of remediating soils to residential standards at a site with DNAPLs.

RCRA Corrective Measures Study. Project Manager. Prepared a RCRA Corrective Measures Study of remediation alternatives for a very large industrial site. Used a risk based cost-benefit analysis which highlighted the technical, environmental, and cost advantages associated with a containment.

General Investigations Project Experience

Extent of Contamination. Project Manager. Estimated the quantity and extent of contamination at several industrial sites from subsurface sampling and analysis. Performed fate and transport modeling to estimate cleanup times associated with various remedial alternatives.

Extent of Gas Migration. Project Manager. Developed and implemented an investigation to determine the extent of landfill gas migration at an inactive landfill.

Extent of Lead. Project Manager. Identified the extent of lead contamination at several industrial and residential properties.

Subsurface Rock Quality. Project Manager. Conducted a subsurface investigation which included coring of over 1,500 feet of rock over abandoned surface and subsurface coal mines. Based on the results, the stability of subsurface conditions were evaluated.

Sediment Investigation. Project Manager. Characterized creek sediments to determine the impact of an adjacent site. Negotiated with EPA to determine a practical and implementable remedial action.

Sediment Investigation. Project Manager. Characterized pond sediment contaminated with metals. Developed and negotiated excavation approach.

Remedial Design/Remedial Action Project Experience

Remedial Design/Remedial Action Site. RD/RA Coordinator. Oversaw the remedial design and remedial action efforts for a 100-acre site with lead and other heavy metal contamination. Implemented an approach which reduced the cost to complete by approximately 50%.

Reduced TCE Concentrations in Soil. Lead Designer and Senior Manager. Used a thermally enhanced soil vapor extraction system at a large Superfund site to reduce TCE concentrations in soil to less than 1 ppm.

Phytoremediation. Project Manager. Managed the implementation of a phytoremediation project designed to remove VOCs in groundwater.

Fast-Track Remedial Investigation/Feasibility Study/Remedial Design/Removal Action Project. Project Manager. Managed and expedited a fast-tracked RI/FS/RD/RA on soils with volatile organic compounds in soil. Developed an EPA approved remedial alternative for these soils and managed all aspects of implementation of this remedy. All activities at this site were completed in less than a year.

Plan and Specifications Development for a Superfund Site. Project Engineer. Developed plans and specifications for a Superfund site with a 60-foot-deep slurry wall with a groundwater pumping and air stripper treatment system.

Quality Assurance/Quality Control Program for a Superfund Landfill. Project Engineer. Developed and managed a QA/QC program for a Superfund landfill (remediation cost, \$30+M). The QA/QC program included analytical and geotechnical testing of sand, clay and geosynthetic components of the landfill liner.

Pre-Design Investigation for a Superfund Site. Project Manager. Coordinated all aspects of a pre-design investigation for a Superfund site. This included developing work plans and implementing a field investigation which included borings, test pits, installation of monitoring wells and a continuous groundwater level monitoring system. Prepared a pre-design summary of site conditions.

Thermally Enhanced Soil Vapor Extraction. Project Manager. Oversaw the implementation of the process for thermally treating soils and sludges using a thermally enhanced soil vapor extraction system at two sites.

Developed Bench-Scale Testing Plans to Test Remediation Alternatives. Project Engineer. Developed and implemented numerous bench-scale testing plans to evaluate cost and technical feasibility of soil washing, solidification/stabilization, grouting and thermal treatment remediation alternatives.

Developed a Pilot-Scale Testing Program for a Feasibility Analysis. Project Engineer. Developed a pilot scale testing program to evaluate the cost and feasibility of using a combustion engine, thermal oxidizer and enclosed flare on landfill gases from a Superfund site.

Hazardous Waste Landfill Design and Specifications. Project Manager. Prepared design drawings and specifications for the remediation of a 60-acre and 8-acre hazardous waste landfill. These designs included composite geomembranes and a soil liner system, and included all surface water management features. Managed quality assurance programs associated with these caps.

Superfund Site Plans and Specifications. Project Engineer/Project Manager. Developed plans and specifications for a Superfund site which included a groundwater extraction system, surface water management system, steel sheetpile retaining wall and 20-foot-deep slurry wall.

Emergency Removal Actions. Project Manager. Oversaw all aspects of emergency removal actions conducted in Indianapolis, IN; Detroit, MI; Atlanta, GA; and Buffalo, NY.

Audits/Compliance Project Experience

Audits. Project Manager. Performed environmental and facility audits associated with property transactions at industrial facilities.

Audits. Project Manager. Led teams of auditors on over 15 industrial audits for compliance with chemical, hazardous waste, and OSHA regulations.

RCRA Part B Permit Application. Project Engineer. Prepared RCRA Part B permit application for an industrial facility, which includes recycling, transfer, storage and disposal operations.

Other Landfill and Surface Impoundment Project Experience

Landfill Cap. Senior Engineer and Project Manager. Prepared the design at an 8-acre landfill cap with geonet and geomembrane liner. The innovative approach used for this design resulted in over \$1 million dollars of cost savings.

Superfund Landfill Design Report. Project Engineer. Developed a design report for a Superfund landfill that evaluated slope stability, surface water management, settlement, geosynthetic liners, construction and post closure costs for several alternative closure scenarios.

Superfund Site Design. Project Manager. Oversaw all facets of the design and remedial action for a cap. Design activities included coordination with the local municipality, the County Conservation District, PADEP, and EPA. Oversaw field quality control activities to confirm that the project was successfully constructed.

Independent Quality Assurance Team Project. IQAT Team Leader. Lead the IQAT team for a Superfund site remediation project. Activities included preparing monthly reports and reviewing submittals, field procedures, and testing.

Infrastructure Project Experience

Geotechnical Investigations. Engineer. Developed and implemented numerous investigations to determine geologic conditions, hydrogeologic conditions, and subsurface contamination. Results were used for design of shallow footings, sheetpile walls, concrete retaining walls, tied back anchor walls, gabion walls, embankments, pressure injected footings, compacted fills and stone columns.

Publications

"TCE Site Groundwater Closure with Risk-Based Pathway Elimination," by K. Hansen, C. Reitman, W. Bowen and W. Richardson, Jr. Presented at the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA. May 2000.

"Evaluation of a Bedrock DNAPL Pool Site," by C.T. Reitman, W.K. Richardson, Jr., and D. Hwang. Proceedings of the Non-Aqueous Phase Liquids (NAPLs) in Surface Environmental Assessment and Remediation Conference; Held in conjunction with the ASCE National Convention. Washington, D.C. 1996.

Continuing Education

- National Safety Council Emergency Care Adult CPR Course, 2011
- 8-Hour OSHA Refresher Training, 2010
- Presented "Greenback from Brownfields: A Planning Process for Value Creation" at the 2008 Business of Brownfields Conference, April 2008
- Natural Attenuation of Chlorinated Solvents in Groundwater, 1998
- 19th Annual Hazardous Waste Symposium, April 1993
- Aeration Technologies for Soil and Groundwater Remediation, St. Louis, MO, 1993

-
- Survival Skills for Running Community Meetings, Philadelphia, PA, 1993
 - Computer Modeling to Solve Groundwater Problems, Princeton, NJ, 1992
 - Hazardous Waste Site Manager/Supervisor, 1992
 - Groundwater Hydrology and Hydraulics, Princeton, NJ, 1990
 - Solidification/Stabilization of Contaminated Sites, Philadelphia, PA, 1990
 - Characterization of Subsurface Contamination, Philadelphia, PA, 1990
 - 40-Hour OSHA Health & Safety Training, July 1989
 - Nuclear Density Gauge Training, February 1987

Professional Affiliations

- Air & Waste Management Association
- National Brownfields Association
- National Ground Water Association

Exhibit R



Remedial Alternatives Comparison of Alternatives

EVALUATION CRITERION	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Excavation/Dredging, Off-site Disposal, And Monitoring	ALTERNATIVE 3 Excavation/Dredging, On-Site Containment of Source Materials, Off-site Disposal of Soil and Sediment, Institutional Controls (ICs) And Long Term Monitoring (LTM)	ALTERNATIVE 4 Excavation/Dredging, On-Site Containment, Off-Site Disposal, Capping, ICs And LTM	ALTERNATIVE 5 Excavation/Dredging, On-Site Containment, Off-Site Disposal, ICs And LTM
Overall Protection of Human Health and the Environment	❌ Does not meet criteria ➢ No action taken to protect human health or environment	✅ Meets criteria ➢ Post-removal samples to confirm protectiveness	✅ Meets criteria ➢ ICs and LTM necessary to maintain protectiveness	✅ Meets criteria ➢ ICs and LTM necessary to maintain protectiveness	✅ Meets criteria ➢ ICs and LTM necessary to maintain protectiveness
Compliance with ARARs	❌ Does not meet criteria ➢ No action taken to meet ARARs	✅ Meets criteria ➢ Compliance through removal and off-site disposal	✅ Meets criteria ➢ Compliance through removal, off-site disposal, on-site containment, ICs and LTM	✅ Meets criteria ➢ Compliance through removal, off-site disposal, on-site containment, capping, ICs and LTM	✅ Meets criteria ➢ Compliance through removal, off-site disposal, on-site containment, ICs and LTM
Long-term Effectiveness and Permanence	❌ Does not meet criteria ➢ No action taken to effectively address site contamination	✅ Meets criteria ➢ Removal and off-site disposal are irreversible	✅ Meets criteria ➢ Effectiveness depends on continuation of ICs and LTM	✅ Meets criteria ➢ Effectiveness depends on continuation of ICs and LTM	✅ Meets criteria ➢ Effectiveness depends on continuation of ICs and LTM
Reduction of Toxicity/ Mobility/ Volume (T/M/V) Through Treatment	❌ Does not meet criteria ➢ No action taken to reduce T/M/V through treatment	Ⓜ Meets some criteria ➢ Treatment only to meet Land Disposal Restrictions (LDR) requirements	Ⓜ Meets some criteria ➢ Treatment only to meet LDR requirements	Ⓜ Meets some criteria ➢ Treatment only to meet LDR requirements	Ⓜ Meets some criteria ➢ Treatment only to meet LDR requirements
Short-term Effectiveness	✅ Meets criteria ➢ No short-term impacts to habitat or local community	Ⓜ Meets some criteria ➢ Temporary impacts to aquatic habitat and local community	Ⓜ Meets some criteria ➢ Temporary impacts to aquatic habitat and local community	Ⓜ Meets some criteria ➢ Temporary impacts to aquatic habitat and local community	Ⓜ Meets some criteria ➢ Temporary impacts to aquatic habitat and local community
Implementability	✅ Meets criteria ➢ No implementability concerns but contamination would remain	✅ Meets criteria ➢ Challenges - slag handling, dewatering and increased traffic	✅ Meets criteria ➢ Challenges - slag handling, dewatering, increased traffic settlement of containment cells and construction near wetlands	✅ Meets criteria ➢ Challenges - slag handling, dewatering, settlement of containment cells, construction near wetlands and cap maintenance	✅ Meets criteria ➢ Challenges - slag handling, dewatering, settlement of containment cells and construction near wetlands
Timeframe	0 years	2 years	2 years for construction 30 years for LTM	2 years for construction 30 years for LTM	2 years for construction 30 years for LTM
Present Worth Cost	\$0	\$78.7 million	\$73.0 million	\$49.8million	\$52.4 million

NL-RBS 000752



Proposed Plan: Raritan Bay Slag

U.S. FOIA Ex. 6

to:

Tanya Mitchell

10/02/2012 09:55 PM

Hide Details

From: U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

To Whom it may concern,

I believe that Alternative #2, taking the contaminants away, is the best way to go for the environment and for all the residents living in this beach community. We all want to enjoy the area we live in without having environmental concerns that potentially could compromise our health.

I have reviewed the Proposed plan and Stongly recommend Alternative 2 as the best option to safely restore the area.

I would oppose any on site storage of contaminated soils or the offending kettle bottoms or battery casings. On site storage will always have the potential for leakage or disturbance by storm or other events.

Storage or containment in a residential area near a school and in a recognized environmentally sensitive area should be avoided.

Alternative 2 represents final removal and closure of community concerns for dangers presented by these contaminants in this recreational area, for human health and for the affect on the wildlife in the marshlands and creatures in the Raritan Bay.

Isabelle Fleming



Comments : Proposed Plan Raritan Bay Slag Superfund Site

U.S. FOIA Ex. 6

to:

Tanya Mitchell

10/02/2012 08:29 PM

Cc:

U.S. FOIA Ex. 6 Pat Seppi

Hide Details

From: U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

Cc: U.S. FOIA Ex. 6 Pat Seppi/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Dear Ms. Mitchell,

I have reviewed the Proposed Plan including Alternatives 1 thru 5. With the exception of # 1 - Do nothing, which would be irresponsible given the hazards in this sensitive environment, all require substantial effort, commitment and time.

My home overlooks the Margaret's Creek site. I have lived here for the past 52 years.

Now that I am retired I walk the beach between Margarets Creek and Whale Creek just after daylight most mornings. Even when I watch the sunrise I can see footprints of people who have already been there, jogging, running, walking their dogs and even fishing. The area is heavily used as it should be. The natural beauty of this area deserves to be preserved and protected for future generations; not from just visible pollution but also from that which we can't see.

In the over 50 years I have lived here I saw the kettle bottoms used as fill and for building up both the seawall and the jetty. I also saw the spreading of battery casings on the road as a substitute for gravel to "improve" the access road between the highway and the beach.

During Northeasters and Hurricanes I have seen the Margaret's Creek

wetlands including the access road inundated and submerged by beach overwash. The storm flooding is accompanied by significant wave action, often carrying heavy timbers and other debris in from the bay. I have seen the flooding and waves follow Margaret's creek to and across State highway 35. At such times our area is cut off from the rest of the township on both the north and south. Although infrequent, the potential for such flooding depends considerably on the condition of the beach (periodic replenishment) the direction, duration and strength of the storm. In any event of this nature the contaminants are disturbed and spread throughout the site in an uncontrolled manner.

I strongly support the preferred Alternative 2 as the best way to remedy the condition and permanently remove the hazards. Alternative 2 represents final action and closure.

Containment on site requires continued monitoring and only puts the final solution off to some future generation.

I appreciate the work so many good people have put into the project. Let's hope things move along and the work is completed in a reasonable time.

William Fleming

U.S. FOIA Ex. 6



Comment to Proposed Plan Raritan Bay Slag Superfund Site

Paulette Mayers to: Tanya Mitchell

10/04/2012 09:25 PM

Cc: Pat Seppi, Donna CAG, Karl Hartkopf, Phil Klimek, Dottie

From: Paulette Mayers <U.S. FOIA Ex. 6>
To: Tanya Mitchell/R2/USEPA/US@EPA
Cc: Pat Seppi/R2/USEPA/US@EPA, Donna CAG <U.S. FOIA Ex. 6>, Karl Hartkopf <U.S. FOIA Ex. 6>, Phil Klimek <U.S. FOIA Ex. 6>, Dottie <U.S. FOIA Ex. 6>

History: This message has been replied to and forwarded.

1 attachment



Response to EPA Proposed plan.wps

Tanya,

Attached is my comment letter to the proposed plan.

Thank you for helping get us Alternative 2

Respectfully,

Paulette Mayers

Paulette Mayers

U.S. FOIA Ex. 6

October 4, 2012

U.S. FOIA Ex. 6

Dear Tanya Mitchell,

Hearing that the EPA has chosen Alternative 2 for their proposed plan in cleaning up the Raritan Bay Slag Superfund site was the **best news** we could have gotten.

After working with you on the CAG for more than 2 years, I was thrilled to hear that all our input, work and time on this project was taken into account. It was reassuring that the EPA listened to our many concerns about the other alternatives for this site and our suggestions for the clean up were the best solution to an enormous problem.

I have lived on Blvd West, which borders the Margaret's Creek Area, since 1968. My family, including 3 sons, enjoyed playing, boating and ice skating on the water behind our home for many years. Not to mention the pleasure we have had observing the enormous amount of wildlife in the wetland area. We have also enormously enjoyed the benefits of living near our beaches and the Raritan Bay.

The Margaret's Creek area serves as a buffer and a barrier for us from the tidal surges and actual flooding that takes place here during severe storms. It helps to control the high tides and drain the excess waters to the bay.

By choosing Alternative 2, hopefully our beaches, jetties and this fragile yet beautiful wetland area will have the contaminants removed, their structure be restored and they will finally be returned to us.

The loss of the use of our beaches and jetties has been a hardship to our community for too many years and I look forward to the day when we can enjoy them again. With the help of all of us, I hope that we can rebuild the area and return and possibly improve the precious commodity that exists here.

I look forward to continue working with the EPA during the clean up and restoration of our beaches, jetties, seawall, park and wetland areas.

I understand this is just the beginning of a long project and that we have to continue to protect our best interest during the removal, the restoration and the completion of the proposed plan. I pray for a completion in a reasonable time frame without complications.

In closing, I completely support Alternative 2 as the best solution to this disaster. By taking the contamination away, instead of burying it on site, we will not have to deal with it again in the future and this brings closure to a most disturbing situation.

Thank you for including us in this project and listening to our suggestions.

Respectfully,

Paulette Mayers



EPA's Preferred Alternative for Clean up of the Raritan Bay.....

Kathleen McNamara to: Tanya Mitchell

10/04/2012 04:08 PM

From:

Kathleen McNamara **U.S. FOIA Ex. 6**

To:

Tanya Mitchell/R2/USEPA/US@EPA

Please respond to Kathleen McNamara **U.S. FOIA Ex. 6**

History:

This message has been replied to and forwarded.

The EPA recently released its plan to remove lead contamination at Raritan Bay Superfund Site in Old Bridge and Sayreville, New Jersey.

I strongly support EPA's preferred clean up recommendation as it will provide the most comprehensive clean up of the contamination and return the beach to unrestricted use.

Kathleen McNamara

U.S. FOIA Ex. 6



EPA's Proposed Clean Up at Raritan Bay Superfund Site
Chrissy Word to: Tanya Mitchell

10/04/2012 11:52 AM

From: Chrissy Word <chrissy@rockingtheboat.org>

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Dear Ms. Mitchell,

I am writing in support of the EPA's proposed Clean Up at Raritan Bay Superfund Sites at Old Bridge and Sayreville, NJ -

http://www.epa.gov/region2/superfund/npl/raritanbayslag/pdf/RBS_final_PRAP.pdf. The proposal appears to me to take an effective approach as it will provide the most comprehensive clean up of the contamination and return the beach to unrestricted use.

Thank you for your consideration,

chrissy word
director of public programs
rocking the boat

812 edgewater road | bronx, ny 10474

718.466.5799 x1219
www.rockingtheboat.org

DRAFT DOCUMENT

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R.W. Chapin, M.S., P.E., President

Board Certified Environmental Engineer

DRAFT MEMO

TO: R. Spiegel, Executive Director, Edison Wetlands Association
Dana Patterson, EWA Program Director & RBS CAG liaison
FROM: R.W. Chapin
RE: Raritan Bay Slag Superfund Site, Townships of Old Bridge & Sayreville, NJ
Proposed Plan Comments
Date: 16 October 2012

Per your request, Chapin Engineering has reviewed the United States Environmental Protection Agency Region 2 [USEPA] Proposed Plan [PP] to address the Raritan Bay Slag Superfund site [RBS]. The Raritan Bay Slag Superfund site is unique to other Superfund Sites in the region due to highly leachable wastes have been deposited on the shoreline of open saline waters, as well as incorporated into shoreline structures. Soil, sediment and surface water contamination are extensive in an unconfined Bay system and will continue to pose a direct threat to human health and environment until the materials are fully removed from this dynamic system.

The USEPA's Proposed Plan [PP] includes excavation/dredging, off-site disposal, institutional controls and long-term monitoring. Slag, battery casing/associated wastes, contaminated soils and sediments above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate in excavated Margaret's Creek upland areas.

This memo provides comments based on the PP presented by the USEPA as well as review of comments by the National Remedy Review Board [NRRB], Region 2's responses to the NRRB, and review of the Feasibility Study [FS] and Remedial Investigation [RI] as needed to understand the basis for the PP. Draft comments on the plan are provided below.

- The PP will remove the wastes and associated contaminated soils and sediments to a secure off-site disposal facility. As presented in the PP, this is to be a "total removal". Given the site is essentially an open bay/ocean environment this is the only option that can provide a permanent solution. **The USEPA's Proposed Plan is the correct technical approach and the only cleanup option that will also restore full public access to the Bay as well as fully restore the associated recreational and economic benefit.**
- The PP commits to removal of specific quantities of wastes, but does not provide any estimate of the mass of contaminated soils and mass of contaminated sediments that must be removed to achieve the remediation goals. A quantitative estimate should be provided in the Record of Decision [ROD].
- The NRRB's comments and Region 2's responses include discussion of Institutional Controls [IC] required for the various alternatives considered. The PP, because it represents a "total removal" should have not IC, but that is not clear. The ROD must specifically state no IC's are required, or if there could be IC associated with the PP, the specifics of those IC and their bases must be clearly stated.
- Lead to the contaminant driving the remediation. USEPA selected a single remediation goal for both the soils and sediments this is the currently utilized NJ soil remediation standard of 400 ppm in residential soils. This choice was based on the rationale that a) this will avoid a "recontamination" issue, i.e., if a lower value was selected for sediments "clean" soil could erode from the shoreline and re-contaminate the sediments and b) the 400 ppm is "protective" of the site specific aquatic environment.
- The NJDEP has an acute sediment screening value of 210 ppm of lead, which apparently was found to not apply to the RBS site; however, the basis for this "non-applicability" is not stated in the PP. The specific rationale for not using the more conservative sediment criteria must be explicitly stated in the ROD.
- We also note that the selected lead remediation goal, 400 ppm, is based on allowable blood lead concentrations is young children of 10 µg/dL [micrograms per deciliter of blood] and that allowable level will be revised downward based on the current literature indicating there is likely no acceptable level of lead in a child's blood. Selecting a more conservative overall lead cleanup concentration of 200 ppm for soil and sediment would be a very prudent approach that the USEPA should take. If the EPA has not done so they must also quantify a cleanup number for Arsenic, Copper and Antimony as these are also contaminants of concern with the slag and impacted sediments.



EPA Cleanup in Laurence Harbor.

Eric to: Tanya Mitchell

10/16/2012 12:30 PM

From: "Eric" <U.S. FOIA Ex. 6>
To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Hello Tanya. I will not be able to make it to the public meeting this week, but please be assured that we are eagerly looking forward to getting Laurence Harbor cleaned up so our kids can enjoy the beach once again.

Blessings,

Eric Karanjawala
Laurence Harbor, NJ

Baykeeper Comments on EPA Proposed Plan for Raritan Slag Remediation

October 17, 2012

NY/NJ Baykeeper strongly supports the EPA's Proposed Plan - Alternative 2- for the clean-up of the Raritan Bay Lead Slag Site through off-site disposal of contaminants. Residents throughout Old Bridge and the vicinity have been concerned about the threat posed to their community and the environment by the lead slag and other contaminants dumped here from the National Lead Company.

Members of the Citizen's Advisory Committee worked incredibly hard for three years to understand the details of the threats posed by this contamination and to advocate for the best long-term solutions for the community and for Raritan Bay. And they have fought hard to make sure that EPA holds the responsible party on the hook for having the slag contamination removed from their community and disposed of properly off-site. Old Bridge no doubt is very proud of these outstanding local residents who have volunteered so much time and been so diligent on behalf of their neighbors.

National Lead proposed a quick low budget plan to evade full responsibility for cleaning this contamination. They want pile up the contamination in a part of the Margaret's Creek area and just put dirt on top of it - they didn't even want to spring for a liner underneath their pile of pollution. Yet they pay their battery of lawyers and consultants plenty to try to limit the clean-up. Old Bridge officials and residents knew better, and thankfully so did EPA.

Baykeeper has worked with Old Bridge environmental commission, officials, and residents to preserve and restore Margaret's Creek for more than a decade. It should remain high quality natural habitat and wetlands that absorb potential floodwaters and provide extraordinary recreational amenities to the public. Decreasing flooding protects people's homes and saves tax dollars. A large toxic landfill would limit the area and rate of storm water absorption and increase flooding.

Areas that have been dumped on and impacted should be cleaned and restored with this objective in mind. We applaud EPA's recommendation for this area, which is to remove slag, battery casings and soil with contamination that exceeds public health and safety standards.

There is still a long way to go, but the proposed remedial alternative 2 focusing on off-site disposal of contaminants is the right way to go. It is a recommendation based on science, public safety and the environment, not short-cuts and savings for the party responsible for the pollution.

Baykeeper would like to thank:

The extraordinary individuals of the Raritan Slag who have dedicated their time and efforts to direct this positive proposed clean-up plan.

All the residents of Old Bridge and Sayreville who have worked to improve their communities and our shared environment.

Congressman Pallone and Senator Menendez for their steadfast leadership on Superfund clean-ups and through a "polluters- pay" approach that saves taxpayers hundreds of millions of dollars.

Old Bridge Mayor Henry and Councilman Volkert along and the other Old Bridge officials who have worked hard for their community on this issue.

And a very hearty thank you to EPA Region II Administrator Judith Enk, Pat Seppi and Tanya Mitchell and the entire EPA Slag team for moving this process along as quickly and soundly as possible.

Thank you,

Greg Remaud
Deputy Director
NY/NJ Baykeeper



Superfund - Raritan Bay NJ
Crowther, Nancy L to: Tanya Mitchell

10/17/2012 03:37 PM

From: "Crowther, Nancy L" U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Hi

As a lifelong resident of Laurence Harbor, I am finding this process very interesting. The slag has been there for 40 years. Old Bridge and Sayreville were always aware of it. As teenagers the boys in the neighborhood would collect the lead to make sinkers to fish. Over twenty years ago, kids had very high lead levels in their systems. It is only now that the EPA is involved that the municipal government is raising alarms and pleading ignorance.

Of course all of our home values dropped due to the publicity. I am not sure we will ever recover what we have lost.

The beach in front of Bayview Drive is not natural. It was all trucked in 30-40 years ago. What they are not saying is that periodically part of it washes away after a storm and munitions are uncovered. Since they put the boulders at the edge, it occurs less frequently, but they are still there. Records from the Old Bridge bomb squad can confirm this as well. Thought you should know in case any digging is done at the edge of the bay

Nancy Crowther



Comment on the Proposed Plan for the Raritan Bay Slag Superfund Site Old Bridge and Sayreville, New Jersey

Fey, Marie D

to:

Tanya Mitchell

10/19/2012 10:30 AM

Hide Details

From: "Fey, Marie D" <Marie.Fey@aig.com>

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Dear Tanya:

I was unable to make the October 17, 2012 meeting at the George bush Senior Center, 1 old Bridge Plaza, Old Bridge, New Jersey. However, I would like my voice heard. I printed out the Proposed Plan and read it. I vote for Alternative 2- Excavating/Dredging, Off-site Disposal and Monitoring.

I reside at **U.S. FOIA Ex. 6** and my backyard overlooks the wetlands between Cliffwood Beach and Laurence Harbor. The wildlife is unbelievable. I have seen ospreys, geese, ducks, foxes, coyotes, turtles, skunks, cranes (blue and white ones), all kinds of wild birds, ground hogs, muskrats, mice, frogs, owls and raccoons. Please make sure the dangerous waste is removed and taken away from this area.

The mosque is also located in this area on Route 35. Please keep the land clean for the grade school children who attend this mosque. Do not dump in their playground.

Above all we must keep the playground and beach clean for the children in Laurence Harbor/Cliffwood Beach. The area must be made free and clean. Please do not clean up by dumping this contaminate waste in proximity to their beaches and playgrounds.

Thank you, MARIE D. FEY | Executive Assistant | **AIG/AMG/Investments and Financial Services** | 80 Pine Street, 11th Floor, New York, NY 10005 | marie.fey@aig.com | T: +1 212 770-3844 | F: +1 212 770-2709

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MARIE D. FEY

U.S. FOIA Ex. 6

October 19, 2012

Ms. Tanya Mitchell
US EPA
290 Broadway, 19th Floor
New York, New York 10007-1866

RE: Public Comment on the Proposed Plan for the Raritan Bay Slag Superfund Site Old Bridge and Sayreville, New Jersey

Dear Tanya:

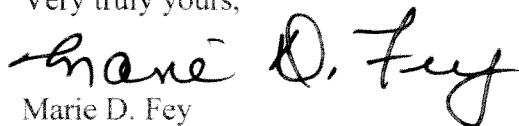
I was unable to make the October 17, 2012 meeting at the George Bush Senior Center, 1 Old Bridge Plaza, Old Bridge, New Jersey. However, I would like my voice heard. I printed out the Proposed Plan and read it. **I vote for Alternative 2- Excavating/Dredging, Off-site Disposal and Monitoring.**

I reside at U.S. FOIA Ex. 6 and my backyard overlooks the wetlands between Cliffwood Beach and Laurence Harbor. The wildlife is unbelievable. I have seen ospreys, geese, ducks, foxes, coyotes, turtles, skunks, cranes (blue and white ones), all kinds of wild birds, ground hogs, muskrats, mice, frogs, owls and raccoons. Please make sure the dangerous waste is removed and taken away from this area.

The mosque is also located in this area on Route 35. Please keep the land clean for the grade school children who attend this mosque. Do not dump in their playground.

Above all we must keep the playground and beach clean for the children in Laurence Harbor/Cliffwood Beach. The area must be made free and clean. Please do not clean up by dumping this contaminate waste in proximity to their beaches and playgrounds.

Very truly yours,


Marie D. Fey



JOHN H. ALLGAIR, 1983-01
DAVID J. SAMUEL, P.E., P.P.
JOHN J. STEFANI, P.E., L.S., P.P.
JAY B. CORNELL, P.E., P.P.
MICHAEL J. McCLELLAND, P.E., P.P.
GREGORY R. VALES!, P.E., P.P.

TIMOTHY W. GILLEN, P.E., P.P.
BRUCE M. KOCH, P.E., P.P.
LOUIS J. PLOSKONKA, P.E.
TREVOR J. TAYLOR, P.E., P.P.
BEHRAM TURAN, P.E.

October 23, 2012

USEPA
290 Broadway, 19th Floor
New York, New York 10007-1866

Attn: Ms. Tanya Mitchell
Remedial Project Manager

**Re: Borough of Sayreville
Raritan Bay Slag Site
Our File No.: PSA00035.01**

Dear Ms. Mitchell:

The proposed improvement alternatives for the remediation of the Raritan Bay Slag Site within the Borough of Sayreville were discussed in detail at the October 22, 2012 meeting of the Mayor and Council.

After a detailed discussion the Governing Body has directed me to advise you that they would concur with the recommendation of the USEPA that Alternative 2 be selected as the preferred remediation alternative.

Should you have any questions regarding this matter, please do not hesitate to contact this office.

Very truly yours,

Jay B. Cornell, P.E.
Borough Engineer's Office

JBC/blr

Enclosure

cc: Mayor and Council
Borough Clerk
Business Administrator
Borough Attorney
Borough Treasurer





Raritan Bay

Pilar Paris

to:

Tanya Mitchell

10/25/2012 07:29 PM

Hide Details

From: Pilar Paris <U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Ms. Mitchell,

I am a resident in Cliffwood beach and use the beach for relaxing walk and other recreational reasons. I have read the plan and am a bit confused on which areas are contaminated. Is Clifford beach area contaminated? My second question, is it possible with renovations that the town consider a dog beach. After speaking with many dog owners in the community; I find that many believe that an enclosed area for the dogs/owners to enjoy without the worries of glass, fish hooks, garbage, etc. I have a pup that loves the beach and water and unfortunately I am constantly worried of her stepping on or trying to eat these items. The most gross has been a feminine product. I think the community would really benefit from something like this and would save a the 20-30 minute drive to the dog park on the other side of Old Bridge.

Thank you for you time and please let me know if this is a possibility or whom I need to contact to discuss this.

Thanks,

Pilar



RARITAN BAY SLAG SUPERFUND SITE

Joe Castelli

to:

Tanya Mitchell

10/29/2012 11:19 AM

Hide Details

From: "Joe Castelli" <[REDACTED]> U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Tanya,

I have been following this closely as I own a business that will be directly impacted. My business is the tackle shop located on Laurence Pkwy across from the jetties. With the current hurricane this all may be a moot point. Anyway, it is very difficult to gauge the impact as specifics to the plan are vague. From a community standpoint, I agree with the option chosen to completely remove the contaminated materials. What, when, and how will determine the extent of damage to local businesses and the environment. I understand there is no business relief fund or compensation for local businesses so I am trying to determine if I need to move from Old Bridge township / Laurence Harbor or just shutdown.

1. Will the entire length of beach be closed for the full duration of the project or will it proceed section by section? If the plan calls for complete closure, our shop will be out of business as well as the hundreds of weekly fishermen looking for new spots to fish. I'm hoping for a systematic approach where each section is completed and reopened before moving on. From a project management standpoint, this makes sense as the majority of the cleanup and time will be at the 2 outside points and not the 3 inner jetties. This minimizes the impact to the middle section and allows the people to continue fishing during the cleanup.
2. What is the understanding of project completion? When the last truck pulls out is the area deemed safe or is there an extended period of time needed for monitoring? I assume there will be residual readings in the water as the ocean will take a certain period of time to cleanse itself. Expected completion is 24 months? Does this take into account weather closures or is that 24 working months?
3. How will the debris be removed? It was mentioned that trucks would drive the beach and unload at a central location. This would require the entire length of beach to be closed. A plan should be in place

for trucks to exit through the nearest route and not be allowed to traverse the beach. This would allow the beach to be accessible in the middle sections. Also, trucks driving the beach would destroy the local eco system. Many fish feed on the crabs, sandworms, bloodworms, and ribbon worms contained in the sand. It could take many years to revive and for some this may never happen.

4. Using a barge was also mentioned. This will require extensive dredging that would ultimately destroy the clam and mussel beds in that area for good.
5. Ecologically we need to protect the environment as much as possible. I have been fishing this bay for 35 years. There have been fish caught this year that either have been absent for a decade or in some cases never before. Once a very popular fish was weakfish. For more than a decade, I have not heard of any being caught. Last year some shorts were caught and this year many legal sized Weakfish were caught. Spot, Trigger, Croaker, and Kingfish have never been caught in the bay and this year they are abundant. Other species as well have been caught in increasing numbers for the first time in many years. We need to minimize the impact of any potential dredging.

I applaud the efforts of the EPA for the work that has been done to this point. Your efforts have demonstrated a concern for the community as well as the environment that go beyond carrying out duties of your job. My concern is choosing a plan and company by the lowest bidder and allowing them to dictate the cleanup plan. This will result in potentially lower capital costs and a greater cost to the environment, community, and local business. I am a computer engineer and not a chemical engineer or marine biologist so will accept the findings of your staff as you have gained my trust.

At this point, I would like to see a more detailed plan with timelines. I also hope that the EPA will dictate the terms of cleanup and removal not allowing the contracted company to utilize cheaper alternatives that may disrupt the surrounding area. From a personal perspective, we would like any info that may assist us with our rent and utility bills if our business hopes to last during the cleanup.

If there is any opportunity to participate in formulating the project plan feel free to reach out to me. I have managed many projects for stock trading systems because of my ability to minimize disruption and downtime while keeping on schedule and within budget. Cleanup is the ultimate goal. Managing expectation, timelines, and impact is the real challenge.

Regards
 Joe Castelli
 Tackle U.S.
 273 Laurence Pkwy
 Laurence Harbor, NJ 08879
 Store: 732-566-4621
U.S. FOIA Ex. 6

No virus found in this message.
 Checked by AVG - www.avg.com
 Version: 2012.0.2221 / Virus Database: 2441/5361 - Release Date: 10/29/12

No virus found in this message.
 Checked by AVG - www.avg.com
 Version: 2012.0.2221 / Virus Database: 2441/5361 - Release Date: 10/29/12



Dear Tanya,
Lynn Olivera to: Tanya Mitchell

11/23/2012 06:39 PM

From: Lynn Olivera **U.S. FOIA Ex. 6**
To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been forwarded.

I think proposal # 2 is the best solution for our area, especially being on the waterfront. We don't know what damage future storms will do, and there may not be funds available to repair or refurbish it again if it is damaged or destroyed. Better to do it right the first time.
Sincerely, Lynn and John Olivera



Raritan Bay Slag Superfund Site

Philip Klimek

to:

Tanya Mitchell

11/24/2012 10:43 AM

Cc:

U.S. FOIA Ex. 6

Hide Details

From: Philip Klimek U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

Cc: U.S. FOIA Ex. 6

History: This message has been replied to and forwarded.

Good Morning Tanya:

I just wanted to go on record one more time supporting Alternative 2 of the proposed remedial clean up plan. The devastating effects of Hurricane Sandy only reinforces what we have been saying all along individually and in the CAG that a major storm would only wipe out and undo any of the lesser alternatives.

Again, thank you to you and all of the other members of EPA involved with this superfund site. I look forward to the Record of Decision when it is presented.

Thank you, Phil Klimek

Philip D. Klimek, P.E.

Contractor, Bastion Technologies

Safety Engineer

CECOM Directorate for Safety

Telephone: (732) 687-0657

Email: U.S. FOIA Ex. 6

Email: U.S. FOIA Ex. 6



U.S. FOIA Ex. 6

to:

Tanya Mitchell

11/27/2012 06:59 PM

Hide Details

From: U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Option #2 is the only option as far as I'm concerned. Moving the contamination from one place in Old Bridge to another is not solving the problem. We need to make Old Bridge whole again and this can only be achieved with option #2.

Debbie Walker
Councilwoman Old Bridge



Raritan Bay Slag Official Comments on the Proposed Plan

Karl

to:

Tanya Mitchell

11/27/2012 05:38 PM

Hide Details

From: Karl [REDACTED] U.S. FOIA Ex. 6

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

Tanya,

In case it wasn't clear in previous emails, and in case you didn't receive the absolute final version of our comments, please accept our comments on the Plan below. Thank you and sorry for any confusion.

Karl

Raritan Bay Slag Community Advisory Group Proposed Plan comments, November 27, 2012

The members of the Raritan Bay Slag Community Advisory Group are honored to represent the communities affected by the Slag and to comment on the EPA's Proposed Plan. The CAG was set up nearly three years ago for the purpose of advising the EPA regarding ongoing study, testing, and cleanup plan formulation on behalf of the community, as well as being a conduit for updating the greater community on these activities.

We are optimistic, albeit cautiously so, that our passionate work to defend the community is succeeding. We wanted the right solution for us, our children, their children AND the environment and it appears that the right solution is indeed the alternative which was chosen.

Having dedicated three years of our lives to fighting for a proper cleanup of the community, we are happy and relieved that alternative two, a removal of the source contaminants and concentrated soil and sediment, was chosen as opposed to landfilling the material in place. Landfilling contaminants in

tidal wetland known for flooding would NOT be protective of us, our children, their children AND the environment. AND WE GET OUR BEACH BACK!

While our quality of life and property values have been temporarily affected by the fence and will continue to be affected during cleanup, they would have been permanently affected if a hazardous landfill was placed in the Margaret's Creek area, Sayreville or anywhere nearby.

Now that the plan calls for material to be removed rather than buried by Margaret's Creek, that area will remain free to absorb water. A landfill would have increased the severity of flooding, erosion and tidal events and severely impacted properties in Cliffwood Beach, Laurence Harbor and the surrounding areas.

No longer will we have to fear health or environmental impacts from the contamination.

No longer will we need to worry that a low-budget landfill situated in the wrong location will cause flooding and erosion near homes, businesses and an active recreation area.

No longer will we be concerned about storm events re-releasing these contaminants into the area.

Our community will not have to suffer under the stigma of a toxic waste landfill near our homes and businesses.

Waterfront and wetlands are precious commodities, and we are delighted that they will be returned to the community.

Margaret's Creek will remain a natural protected area, allowing its wetlands to control stormwater and flood tides, as well as provide a home for native plants, animals and the ecosystems they inhabit.

Sayreville's waterfront site will not be forever buried under a hazardous landfill but freed for future use.

This solution might not be the quickest, but it is the most appropriate solution, leaving us without the problems of a smash and grab cleanup. And so far, the Superfund process for this site is moving faster than for most other Superfund sites in New Jersey. We hope the momentum keeps up.

We still have some work ahead of us; we will continue to campaign for proper restoration of the uplands, wetlands, seawall, and beach, actions not yet detailed in any of the alternatives. But Alternative 2 is the right option. Not just for Cliffwood Beach, Laurence Harbor and Old Bridge and Sayreville as a whole, but for all who enjoy the park and surrounding natural areas.

In addition to supporting the EPA's selection of Alternative 2 as the preferred cleanup alternative, the CAG would like to request that

1. The EPA work towards a speedy Record of Decision and Remedial Design, in order to keep up the fast pace of progress that has been maintained thus far, and that
2. The Record of Decision not be contingent upon involvement of the Responsible Parties or Potentially Responsible Parties.

We would like to take this opportunity to heartily thank the staff of the Environmental Protection Agency for its efforts on behalf of our community, particularly Tanya Mitchell and Pat Seppi for their tireless work with our group. Our incessant questioning and highly animated discussions surely tried their patience and we are grateful that they continued to engage us in spite of that.

We would also like to recognize the New York / New Jersey Baykeeper, Edison Wetlands Association, and Raritan River Keeper for joining our CAG and for their advice and guidance during this process.

Finally, we would like to thank elected officials of the Town of Old Bridge from this administration and the last, as well as Congressman Pallone, Senator Menendez and Senator Thompson for keeping us on their radar.

The EPA is taking the right step here, and we look forward to working with you on the next right step.

Sincerely,
Members of the Raritan Bay Slag Community Advisory Group
November 27, 2012



Township of Old Bridge Resolution re Slag Superfund
Patricia Greene

to:

Tanya Mitchell

11/27/2012 02:23 PM

Hide Details

From: "Patricia Greene" <PAGreene@oldbridge.com>

To: Tanya Mitchell/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

1 Attachment



SLAG FUND.pdf

I would appreciate your acknowledging receipt of this attachment. Thank you.

Patricia A. Greene

Office of the Township Clerk

Township of Old Bridge

One Old Bridge Plaza

Old Bridge, NJ 08857

732-721-5600 Ext. 2205

***** ATTACHMENT NOT DELIVERED *****

This Email message contained an attachment named
image001.jpg

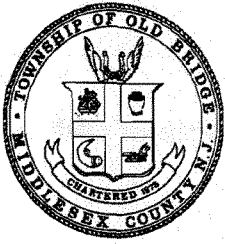
which may be a computer program. This attached computer program could contain a computer virus which could cause harm to EPA's computers, network, and data. The attachment has been deleted.

This was done to limit the distribution of computer viruses introduced into the EPA network. EPA is deleting all computer program attachments sent from the Internet into the agency via Email.

If the message sender is known and the attachment was legitimate, you should contact the sender and request that they rename the file name extension and resend the Email with the renamed attachment. After receiving the revised Email, containing the renamed attachment, you can rename the file extension to its correct name.

For further information, please contact the EPA Call Center at (866) 411-4EPA (4372). The TDD number is (866) 489-4900.

***** ATTACHMENT NOT DELIVERED *****



TOWNSHIP OF OLD BRIDGE

One Old Bridge Plaza
Old Bridge, New Jersey 08857

Stella Ward
Township Clerk

Phone: (732) 721-5600 ext. 2211
Fax: (732) 607-7944

November 27, 2012

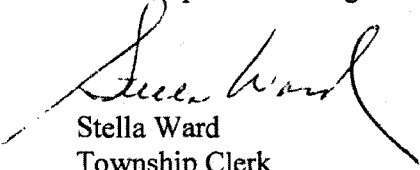
Ms. Tanya Mitchell
US EPA
290 Broadway – 19th Floor
New York, NY 10007-1866

Dear Ms. Mitchell:

Enclosed is a resolution of the Township Council of the Township of Old Bridge dated November 19, 2012 supporting the EPA's clean up of the Raritan Bay Slag Superfund Site.

Very truly yours,

Township of Old Bridge


Stella Ward
Township Clerk

Be it Resolved, by the Township Council of the Township of Old Bridge, County of Middlesex, New Jersey, that:

1/3

**RESOLUTION NO. 413-12
SUPPORTING EPA'S CLEAN UP OF RARITAN BAY SLAG SUPERFUND SITE**

WHEREAS, the Raritan Bay Slag Superfund Site (hereinafter the "Site") is located on the shore of the Raritan Bay in the eastern part of Old Bridge Township within the Lauren Harbor section; and

WHEREAS, the slag was deposited at the beachfront in the late 1960s and early 1970s, mostly in the form of blast furnace pot bottoms or kettle bottoms from a secondary lead smelter, in an area that had sustained significant beach erosion and damage due to a series of storms in the 1960s; and

WHEREAS, elevated levels of lead, antimony, arsenic, copper, and chromium were identified by the New Jersey Department of Environmental Protection (NJDEP) in soil along the seawall in 2007 and at the edge of the beach near the western end of the seawall; and

WHEREAS, the EPA collected samples at the Site in September 2008 as part of an Integrated Assessment for purposes of determining whether further action under CERLA was needed; and

WHEREAS, the NJDEP and EPA analytical results determined that elevated levels of lead and other heavy metals were present at the Site; and

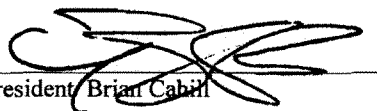
WHEREAS, it was later determined that due to the elevated lead levels, a public health hazard existed at the Site and on April 24, 2008, the EPA received a request from the NJDEP to evaluate the Site for a removal action under CERLCA; and

WHEREAS, in November 2009 the site was listed on the EPA's National Priorities list; and

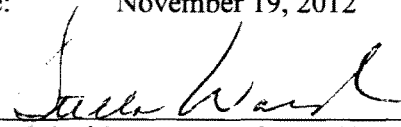
WHEREAS, Remedial Investigation (RI) field activities were conducted on the Site from September 2012 through June 2011; and

WHEREAS, subsequent to its completion of its remedial investigation, in September 2012, the EPA announced a proposed plan identifying the preferred alternatives for addressing the site-wide soils and sediments at the Site (hereinafter the "Proposed Plan"); and

I certify the following to be a true and correct abstract of a resolution regularly passed at a meeting of the Township Council of the Township of Old Bridge


President Brian Cabill

Date: November 19, 2012


Clerk of the Township of Old Bridge

Be it Resolved, by the Township Council of the Township of Old Bridge, County of Middlesex, New Jersey, that:

2/3

RESOLUTION NO. 413-12

WHEREAS, the Proposed Plan provided five (5) remedial alternatives addressing the methodology of clean up at the Site; and

WHEREAS, the EPA indicated in the Proposed Plan that it is recommending Remedial Alternative 2, identified as Excavation/Dredging, Off-site Disposal, and Long-Term Monitoring (hereinafter "Alternative 2"); and

WHEREAS, the member of the Community Advisory Group (CAG) appeared before the Township Council at its meeting on October 15, 2012 to voice their support for Alternative 2; and

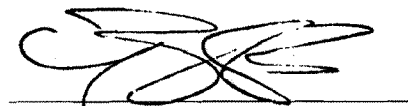
WHEREAS, the Mayor and Township Council are concerned about the clean up of the Site to ensure of the health and safety of the residents living in Cliffwood Beach, Laurence Harbor and the surrounding areas; and

WHEREAS, the Mayor and Township Council wish to ensure that the Township's waterfront and wetlands are protected and returned to the residents of Old Bridge for their use and enjoyment; and

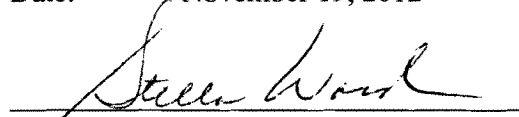
WHEREAS, in order to meet these goals and objectives, it is necessary for the EPA to implement a clean up alternative that is complete and in the best interests of the Township's residents, but at the same time, in a manner in which the Township of Old Bridge's interests are protected.

NOW THEREFORE, BE IT RESOLVED by the Township Council of the Township of Old Bridge that it does hereby urge the EPA to proceed with implementing a clean up alternative, including Alternative 2 as stated in the EPA's Proposed Plan and to ensure that such alternative will remain in the best interests of the Township of Old Bridge and its residents.

I certify the following to be a true and correct abstract of a resolution regularly passed at a meeting of the Township Council of the Township of Old Bridge


President Brian Cahill

Date: November 19, 2012


Clerk of the Township of Old Bridge

Be it Resolved, by the Township Council of the Township of Old Bridge, County of Middlesex, New Jersey, that:

3/3

RESOLUTION NO. 413-12

BE IT FURTHER RESOLVED by the Township Council of the Township of Old Bridge that it does hereby urge the EPA to have the clean up fully funded by the Federal government and/or National Lead; the Township not be required to pay any amount for the clean-up; Federal government and/or National Lead will restore the beach, park and neighborhood to the pre-contaminated-like state (s) before the beach was closed; and Federal government and/or National Lead complete the project within three (3) years.

Moved by Councilman Greene, seconded by Councilman Calogera and so ordered on the following roll call vote:

AYES: Councilmen Anderson, Butler, Calogera, Greene, Volkert, Councilwomen Panos, Sohor, Walker, President Cahill.

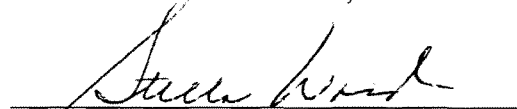
NAYS: None.

I certify the following to be a true and correct abstract of a resolution regularly passed at a meeting of the Township Council of the Township of Old Bridge



President Brian Cahill

Date: November 19, 2012



Clerk of the Township of Old Bridge



Raritan Bay Slag Superfund Site Proposed Plan Public Comment letter & memo
dana

to:

Tanya Mitchell

11/27/2012 04:18 PM

Cc:

Pat Seppi, Judith Enck, Walter Mugdan

Hide Details

From: <dana@edisonwetlands.org>

To: Tanya Mitchell/R2/USEPA/US@EPA

Cc: Pat Seppi/R2/USEPA/US@EPA, Judith Enck/R2/USEPA/US@EPA, Walter
Mugdan/R2/USEPA/US@EPA

History: This message has been replied to and forwarded.

4 Attachments



icon_sm_facebook.gif icon_sm_twitter.gif attybhbby.pdf attx1bsa.pdf

Dear Ms. Mitchell,

On behalf of the environmental nonprofit organizations Edison Wetlands Association, New Jersey Food and Water Watch, New Jersey Conservation Foundation, New Jersey Public Employees for Environmental Responsibility, NY/NJ Baykeeper, New Jersey Sierra Club, Raritan Riverkeeper and Clean Ocean Action, please find the attached cover letter and technical memo for the Proposed Plan public comment period to the United States Environmental Protection Agency (USEPA) for the Raritan Bay Slag Superfund Site, Old Bridge and Sayreville, New Jersey.

If you have any questions, I can be reached at 732-321-1300. Thank you for your consideration.

Respectfully,

Dana Patterson
Program Supervisor

Edison Wetlands Association
732-321-1300

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Ms. Tanya Mitchell
Remedial Project Manager, Region 2
U.S. Environmental Protection Agency
290 Broadway, 19th Floor
New York, New York 10007

RE: Proposed Plan Comments
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, New Jersey

November 27, 2012

Dear Ms. Mitchell,

On behalf of the environmental nonprofit organizations Edison Wetlands Association, New Jersey Food and Water Watch, New Jersey Conservation Foundation, New Jersey Public Employees for Environmental Responsibility, NY/NJ Baykeeper, New Jersey Sierra Club, Raritan Riverkeeper and Clean Ocean Action, please find the attached memo for the Proposed Plan public comment period to the United States Environmental Protection Agency (USEPA) for the Raritan Bay Slag Superfund Site, Old Bridge and Sayreville, New Jersey.

We are in support of USEPA's selected remedy, Alternative 2, identified as Excavation/Dredging, Off-site Disposal, and Long-Term Monitoring. Our technical comments are attached via a memorandum from our technical consultant, Chapin Engineering, which discusses improving the effectiveness of the selected remedy.

We are extremely concerned with the current direct and immediate threat to public health and the environment, which will continue to expand unabated until all of the kettle bottoms and contaminated sediments are completely removed and taken off-site for disposal at a proper USEPA-certified hazardous waste landfill. This slag is leaching high levels of lead, arsenic, copper and antimony into Raritan Bay, Cheesequake Jetty, and Margaret's Creek wetlands. Due to the tidal bay and constant erosion of our beach, all capping methods are unacceptable, and must not be considered. The lead slag must be removed from the beach and transported off-site immediately, so the residents can swim, sunbathe and fish safely. We understand that USEPA is in agreement with this as their selected remedy Alternative 2 will address these issues.

In order to implement Alternative 2 safely, effectively, and have as little impact on the residents as possible, we recommend that USEPA utilize a barge during excavation. This would greatly reduce the amount of truck traffic traveling thorough the neighborhoods. We suggest using the local facility Bayshore Recycling to transfer out the waste. This facility has both rail and barge access, which could be used to take the waste to the appropriate hazardous waste landfill. Additionally, during the reconstruction of the Route 35 Bridge adjacent to

Cheesequake Creek, some barge activity was used. This means that the area surrounding Cheesequake Creek is viable to use a barge to remove the slag on the jetty.

After the devastation of Hurricane Sandy, it is clear that total removal of these wastes is the only option, and must be implemented immediately. We suggest that USEPA accelerate the Record of Decision and Remedial Design before any additional catastrophic storms hit, which could drastically move slag or sediments into sections of the bay that are not contaminated as we saw during Hurricane Sandy.

We also support long-term monitoring of this site, which is important to ensure that any related contamination in the area has been identified and removed, and no longer poses risks to the public or the environment.

Thank you in advance for taking our recommendations in to serious consideration. If you have any questions or would like to discuss this future, Robert Spiegel of Edison Wetlands Association will serve as the point of contact and can be reached at 732-321-1300 or via email at rspiegel@edisonwetlands.org.

Respectfully,

Robert Spiegel
Executive Director
Edison Wetlands Association

Emile DeVito, Ph.D.
Manger of Science and Stewardship
New Jersey Conservation Foundation

Jim Walsh
Director
New Jersey Food and Water Watch

Bill Wolfe
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R.W. Chapin, M.S., P.E., President
Board Certified Environmental Engineer

MEMO

TO: R. Spiegel, Executive Director, Edison Wetlands Association
FROM: R.W. Chapin
RE: Raritan Bay Slag Superfund Site, Townships of Old Bridge & Sayreville, NJ
Proposed Plan Comments
Date: 25 November 2012

Per your request, a review of the United States Environmental Protection Agency Region 2 [USEPA] Proposed Plan [PP] to address the Raritan Bay Slag Superfund site [RBS] was conducted. The RBS is a unique Superfund site where highly leachable wastes have been deposited on the shoreline of open saline waters, as well as incorporated into shoreline structures. Soil, sediment and surface water contamination are extensive.

The USEPA's Proposed Plan [PP] includes excavation/dredging, off-site disposal, institutional controls and long-term monitoring. Slag, battery casing/associated wastes, contaminated soils and sediments above the remediation cleanup levels would be excavated and/or dredged and disposed of at appropriate off-site facilities. The Margaret's Creek wetland sediments would not require restoration, but certified clean material/fill/sands would be placed as appropriate in excavated Margaret's Creek upland areas.

This memo provides comments based on PP presented by the USEPA [both the written PP and presentations at the public hearing] as well as review of comments by the National Remedy Review Board [NRRB], Region 2's responses to the NRRB, and review of the Feasibility Study [FS] and Remedial Investigation [RI] as needed to understand the bases for the PP. Comments are provided below.

- The PP will remove the wastes and associated contaminated soils and sediments to secure off-site disposal. As presented in the PP, this is to be a "total removal". Given the site is essentially an open ocean environment this is the only option that can provide a permanent solution. USEPA is applauded and thanked for selecting the "right" solution for the local residents and the environment.
- As noted in my presentation at the public hearing, the location of the RBS on an open shoreline makes total removal the only option. Hurricane Sandy caused major havoc to the RBS and illustrates the wisdom of the PP. In addition, I note that review of the NOAA aerial photos for the site post-Sandy illustrate how the containment area proposed by NL Industries for Margaret's Creek would have been impacted by this storm and is not a protective option.
- The PP commits to removal of specific quantities of wastes, but does not provide any estimate of the mass of contaminated soils and mass of contaminated sediments that must be removed to achieve the remediation goals. A quantitative estimate should be provided in the Record of Decision [ROD].
- The NRRB's comments and Region 2's responses include discussion of Institutional Controls [IC] required for the various alternatives considered. The PP, because it represents a "total removal" should have not IC, but that is not clear. The ROD must specifically state no IC's are required, or if there could be IC associated with the PP, the specifics of those IC and their bases must be clearly stated.
- Lead is the contaminant driving the remediation. USEPA selected a single remediation goal for both the soils and sediments this is the currently utilized NJ soil remediation standard of 400 ppm in residential soils. This choice was based on the rationale that a) this will avoid a "recontamination" issue, i.e., if a lower value was selected for sediments "clean" soil could erode from the shoreline and re-contaminate the sediments and b) the 400 ppm is "protective" of the site specific aquatic environment.
- The NJDEP has an acute sediment screening value of 210 ppm of lead, which apparently was found to not apply to the RBS site; however, the basis for this "non-applicability" is not stated in the PP. The specific rationale for not using the more conservative sediment criteria must be explicitly stated in the ROD.
- We also note that the selected lead remediation goal, 400 ppm, is based on allowable blood lead concentrations in young children of 10 µg/dL [micrograms per deciliter of blood] and that allowable level will be revised downward based on the current literature indicating there is likely no acceptable level of lead in a child's blood. Selecting a more conservative overall clean lead cleanup concentration of 200 ppm for soil and sediment would be a very prudent approach that the USEPA should take.

Susan Lopez

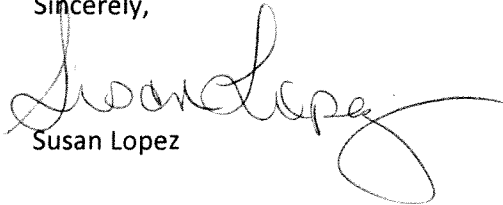
U.S. FOIA Ex. 6

A large black rectangular redaction box covers the area below the "U.S. FOIA Ex. 6" text.

To whom it may concern,

I am a resident of the Cliffwood Beach section of Oldbridge and have many concerns regarding the Raritan Bay Slag. I have carefully read the EPA clean up proposal and feel that the only true means of riding the contamination is by choosing alternative 2, excavating/dredging, offsite disposal and monitoring. This clean up needs to take priority and start as soon as possible. After the Hurricane the storm surge has moved many of these affected areas and will continue to migrate and affect the health and well being of the residents of these communities.

Sincerely,

A handwritten signature in cursive script, appearing to read "Susan Lopez", is written over the typed name.

Susan Lopez



**STATEMENT OF WORK
FOR THE REMEDIAL DESIGN AND REMEDIAL ACTION
RARITAN BAY SLAG SUPERFUND SITE**

Townships of Old Bridge/Sayreville, Middlesex County, State of New Jersey

EPA Region 2

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1.0 INTRODUCTION

1.1 Summary of Site Conditions

The Raritan Bay Slag Site is approximately 1.5 miles in length and consists of the waterfront area between Margaret's Creek and the areas just beyond the western jetty at the Cheesquake Creek Inlet (See Figure 1). For ease of discussion and reference locations, the Site has been divided into eleven areas as shown in Figure 2. These areas have been grouped into three sectors based on the type of environment and proximity to source areas; sectors include the Seawall Sector (Areas 1, 2, 3, 4, 5, and 6), the Jetty Sector (Areas 7, 8 and 11), and the Margaret's Creek Sector (Area 9). Since Raritan Bay is relatively calm during normal conditions, the majority of sediment movement occurs during storms. Waves in the Bay originate predominantly from the east and northeast (Atlantic Ocean). Thus contaminants from the Seawall and Margaret's Creek Sectors tend to migrate westward. Currents near the Jetty Sector are complex due to strong tidal currents within Cheesquake Creek. This complicated environment dictates a specific sequencing of cleanup activities to prevent recontamination of remediated areas. The sequencing to prevent recontamination is as follows: the Margaret's Creek Sector; the Seawall Sector; then the Jetty Sector.

The primary sources of contamination are slag from a lead reclamation process and battery casings. The seawall is up to 80 percent slag. Battery casings were found in the upper two inches of depositional zones in Areas 2 and 5. Buried slag was observed in test excavations on the upland side of the seawall in Area 1 and the eastern end of Area 4. The Western Jetty and adjacent areas contain slag and some battery casings. The western side of the Western Jetty and the adjacent shoreline are comprised of 80 to 90 percent slag. The prevailing currents in the vicinity of the Western Jetty promote sediment deposition on the western side of the jetty and transport of sediment into Raritan Bay. Margaret's Creek contains visible slag waste piles in upland areas of Margaret's Creek. Crushed battery casings were also observed scattered in upland areas of Margaret's Creek. No slag or battery casings were observed in the wetland sediment.

1.2 Description of the Selected Remedy

On May 23, 2013 EPA issued a Record of Decision (ROD) selecting the final Remedy for the Site. The Remedy addresses the slag and battery casings and associated wastes, and contaminated and highly impacted soil and sediment and consists of the following major components and subcomponents.

- Pre-design investigation
- Removal of all source materials and contaminated soil and sediment in all areas, including:
 - Segregation and removal of slag
 - Removal of battery casings and associated wastes
 - Excavation of contaminated soils and dewatering if necessary
 - Dredging and dewatering of contaminated sediment including hot spots

- Post-removal inspection and sampling
- Transport and off-site disposal of excavated/dredged/removed materials
- Restoration of areas impacted by slag and battery casings and associated wastes, excavated areas and dredged areas (if necessary)
- Coastal wetland restoration and monitoring in bay area wetlands
- Surface water monitoring
- Green remediation considerations
- Permitting

In the Jetty and Seawall Sectors, the term “soil” refers to all contaminated solids other than slag, and battery casings and associated wastes that lie upland of the mean high tide line. The term “sediment” in the Jetty and Seawall Sectors refers to all contaminated solids other than slag and battery casings and associated wastes seaward of the mean high tide line. In the Margaret’s Creek Sector, the term “sediment” refers to solids that are submerged in water, and the term “soil” refers to solids other than the slag and battery casings and associated wastes that are on dry land.

Slag, battery casings and associated wastes shall be excavated based on visual observation and disposed of at appropriate off-site facilities. Slag materials that are not readily visible will be remediated as soil/sediment. Contaminated soils and sediment above the lead remediation cleanup level of 400 mg/kg shall be excavated and/or dredged and disposed of at appropriate offsite facilities. By removing the above-referenced wastes, surface water contamination will be reduced to acceptable levels over time. Monitoring shall be implemented to ensure the effectiveness of the remedy by achieving the remedial goals presented in Table 1-1.

Table 1-1 Cleanup Levels for Chemicals of Concern for the Selected Remedy

Media	Chemical of Concern	Cleanup Level
Soil and Sediment	Lead	400 mg/kg ^a
Surface Water	Arsenic	36 ug/L ^b
	Copper	3.1 ug/L ^b
	Iron	1,000 ug/L ^c
	Lead	24 ug/L ^b
	Manganese	120 ug/L ^d
	Vanadium	20 ug/L ^d
	Zinc	81 ug/L ^b

^aNJDEP Soil Remediation Standard for residential soils

^bNJDEP Surface Water Quality Standard

^cNational recommended Water Quality Criterion

^dEPA Biological Technical Assistance Group screening benchmark

Although a five-year review would not be required since this Remedy results in an unlimited use/unrestricted exposure scenario, a policy review may be conducted within five years of

completion of construction if all Remedial Action Objectives (RAOs) have not yet been achieved.

1.3 Work to be Performed

Respondent shall design, implement, operate and maintain the remedy in accordance with the Raritan Bay Slag ROD, this Statement of Work (SOW), including the Remedial Design (RD) and Remedial Action (RA) Schedules, the Performance Standards, and all deliverables created under this SOW and approved by the U.S. Environmental Protection Agency (EPA).

The Performance Standards include all Applicable or Relevant and Appropriate Requirements (ARARs), cleanup goals, cleanup levels, cleanup standards, specifications and all measures for the performance response actions selected in the ROD and treatment processes, engineering controls and other controls set forth in the ROD, the SOW and any deliverable created and approved under the Unilateral Administrative Order (UAO) and the SOW.

2.0 DEFINITIONS

Unless otherwise expressly provided in the SOW, the terms used in the SOW that are defined in CERCLA, in regulations promulgated under CERCLA, or in the UAO, have the meanings assigned to them in CERCLA, in such regulations, or in the UAO. Whenever terms listed below are used in the SOW or in any attachment hereto, the following definitions apply:

Unilateral Administrative Order - means the Unilateral Administrative Order (CERCLA --02-2014-2012) and all appendices attached thereto to which this SOW is an Appendix.

Operation and Maintenance or O&M - means all activities required to operate, maintain, and monitor the effectiveness of the Remedial Action as required under the O&M Manual.

Paragraph or Section - means a paragraph of the SOW, unless otherwise stated.

Performance Standards - means the cleanup standards and other measures of achievement of the goals of the RA, as set forth in the ROD.

RA - means the Remedial Action or Remedy selected in the ROD for the Site.

RA Schedule - means the schedule set forth in Section 7.3 or any proposed revised RA Schedule submitted under this SOW and approved by EPA.

RD - means the Remedial Design for those activities to be undertaken by the Respondent to develop final plans and specifications for the RA as specified in the SOW.

RD Schedule - means the schedule set forth in Section 7.2, or any proposed revised RD Schedule submitted under this SOW and approved by EPA.

Record of Decision or ROD - means the EPA Record of Decision issued on May 23, 2013.

Respondent – means NL Industries, Inc.

Statement of Work or SOW - means the statement of work that describes the activities the Respondent shall carry out to implement the RA, the RD and Operation and Maintenance regarding the Site.

Supporting Deliverables - means any document or deliverable defined to correspond with its use in Section 6.3 and Schedules found in Sections 7.2 and 7.3.

Work - means all activities and obligations Respondent is required to perform under the UAO, except the activities required under Section XX of the UAO (Record Preservation).

3.0 COMMUNITY INVOLVEMENT AND TECHNICAL ASSISTANCE

3.1 Community Involvement Responsibilities

If requested by EPA, Respondent shall support EPA's community involvement activities. This may include providing initial submissions and updates of plans, reports or other deliverables to (i) Community Advisory Groups, (ii) Technical Assistance Grant recipients and their advisors, and (iii) other entities in order to provide them with a reasonable opportunity for review and comment. All community involvement activities conducted by Respondent at EPA's request are subject to EPA's oversight and approval.

Community Affairs Liaison If requested by EPA, Respondent shall, within 15 days, designate and notify EPA of Respondent's Community Affairs Liaison. Respondent may hire a contractor for this purpose. Respondent's notice must include the name, title, and qualifications of the Community Affairs Liaison. The Community Affairs Liaison will be responsible for responding to EPA's request regarding the public's inquiries about the site.

4.0 REMEDIAL DESIGN

4.1 Remedial Design Work Plan

Respondent shall submit a RD Work Plan (RDWP) for EPA approval. The RDWP shall be prepared in accordance with the EPA Remedial Design/Remedial Action Handbook, EPA 540/R-95/059 (June 1995), and any subsequent updates. The RDWP shall provide for the sequencing of RD and RA activities as follows: Margaret's Creek, Seawall and Jetty Sectors.

The RDWP shall include:

1. The identity of, contact information for, and description of the roles of the members of Respondent's RD project team, including the Project Coordinator, QA Official and Supervising Contractor; independent QA Official if IQAT is used;
2. Plans and schedules for implementing all RD activities identified and any pre-design tasks identified in this SOW, or required by EPA to be conducted in order to develop the RD;
3. A description of the overall management strategy for performing any pre-design investigations and the RD, and a general approach to contracting, construction, operation, maintenance, and monitoring of the RA as necessary to implement the Work;
4. A proposal for a design/build approach to the design and construction whereby the design is developed to about the 60 percent completion level followed by subsequent field engineering during pre-construction or construction. The design/build approach provides flexibility regarding further Site characterization activities and allows for deferring some pre-design sampling until later in the design or in the construction stage. The design/build proposal should clearly identify any aspects of the pre-design investigation that will be deferred. EPA will determine if conditional acceptance of the approach is appropriate as part of RD Work Plan approval process. EPA will make a final determination regarding the approach with the approval of the 30 percent design;
5. A description of the responsibility and authority of all organizations and key personnel involved with the development of the RD;
6. Descriptions of any areas requiring clarification and/or anticipated problems (e.g., data gaps) and the approach to be used to address those problems;
7. A preliminary outline of any drawings and specifications including any sample design sheets and proposed templates to be used in the design (e. g. , drawing template, spec template, basis of design template, format for data management systems and coordinate systems, etc.);
8. A description of the proposed design quality assurance approach (e. g., peer review, etc.);
9. A description of permitting, substantive permitting requirements, ARARs and other regulatory requirements;
10. A description of how the RD and the RA will follow EPA's Superfund Green Remediation Strategy to ensure that the entire project incorporates options to minimize the environmental footprints of the cleanup action;

11. A description of plans for, and a schedule for, coordination with, and access from, entities affected by, or that may affect the Work (e.g., property owners, state agencies, local agencies, etc.), such as access, permitting, property acquisition, property leases, and/or easements required for implementation of the RD and RA;
12. A schedule for completion of the Remedial Action Work Plan including Supporting Deliverables and Schedule as specified in Sections 6.3, 7.2 and 7.3.

4.2 Treatability Pilot Study

Respondent may perform a Treatability Study (TS) for the separation of lead contamination from soils and sediment in the Seawall and Jetty Sectors.

If Respondent elects to perform a TS, Respondent shall submit a TS Work Plan (TSWP) with the RDWP for EPA approval. Respondent shall prepare the TSWP in accordance with EPA's Guide for Conducting Treatability Studies under CERCLA, Final (October 1992) as supplemented for RD by the Remedial Design/Remedial Action Handbook, EPA 540/R-95/059 (June 1995).

In accordance with the schedule in the EPA-approved TSWP, Respondent shall submit a TS Evaluation Report for EPA approval.

EPA may require Respondent to supplement the TS Evaluation Report and/or to perform additional treatability studies.

4.3 Pre-Design Investigation

The purpose of the Pre-Design Investigation (PDI) is to address data gaps by conducting additional field investigations to ensure the complete removal of all slag, battery casing/associated wastes and contaminated and highly impacted soils and sediment. The pre-design investigation shall review historical data as appropriate, refine the remediation areas and obtain any additional parameters, which may include analytical, hydro-geological or geochemical parameters. Results from the pre-design investigation shall be used to (1) estimate the area and volume of excavation; (2) delineate the vertical extent of slag and battery casings and associated wastes through test pits or other methods; (3) characterize separate waste streams (i.e., slag, battery casings and associated waste) for appropriate disposal. The PDI shall collect additional geotechnical data including soil cores near the seawall, the Western Jetty and Margaret's Creek upland areas and as needed samples to determine the ability of soil to withstand the loads during construction activities.

The PDI may be conducted in stages to support the sequencing of implementation of components of the remedy. As discussed in Section 4.1, the Respondent may propose integrating PDI sampling activities into subsequent stages of the RD/RA process as part of a design/build proposal.

4.3.1 Pre-Design Investigation Work Plan

Respondent shall submit a PDI Work Plan (PDIWP) for EPA approval in accordance with the schedule in the EPA-approved RDWP. Such schedule may provide for deferring PDI work to a subsequent RD/RA stage. The PDIWP shall include:

1. An evaluation and summary of existing data and description of data gaps;
2. A sampling plan including media to be sampled, contaminants or parameters for which sampling will be conducted, location (areal extent and depths) and number of samples;
3. Cross reference to Quality Assurance/Quality Control (QA/QC) requirements set forth in the Quality Assurance Project Plan (QAPP) referenced in Section 6.6.7 below; and
4. A schedule for conducting the PDI including, where appropriate deferring sampling until the construction process.

4.3.2 Pre-Design Investigation Evaluation Report

Unless otherwise approved by EPA as part of a design/build approach referenced in Section 4.1, above, following completion of the PDI(s) Respondent shall submit a PDI Evaluation Report(s). This report(s) must include:

1. Summary of the investigations performed;
2. Summary of investigation results including figures and maps with sampling locations and concentrations;
3. Summary of validated data (i.e., tables and graphics);
4. Data validation reports and laboratory data reports;
5. Narrative interpretation of data and results;
6. Results of statistical and modeling analyses;
7. Copies of field notes and log books;
8. Photographs documenting the work conducted; and
9. Conclusions and recommendations for RD, including resultant design parameters and criteria.
10. EPA may require Respondent to supplement the PDI Evaluation Report and/or to perform additional tasks.

4.4 Preliminary (30%) Remedial Design

In accordance with the schedule in the EPA-approved RDWP Respondent shall submit a Preliminary (30%) RD(s) for EPA's comment. The Preliminary RD(s) shall include:

1. A design criteria report, as described in the Remedial Design/Remedial Action Handbook, EPA 540/R-95/059 (June 1995);
2. Design assumptions and parameters, including design restrictions, process performance criteria, appropriate unit processes for any treatment train and expected removal or treatment efficiencies for both the process and waste (concentration and volume);
3. Preliminary plans, drawings and sketches, including design calculations and restrictions;
4. Results of any additional field sampling;
5. Proposed cleanup verification methods, including compliance with ARARs;
6. Expected monitoring and operation requirements;
7. A description of Respondent's proposed Project Delivery and RA contracting strategy;
8. Descriptions of permit requirements and schedule;
9. Real estate acquisition through any purchases or easements that are necessary to implement the RA;
10. Preliminary O&M Manual;
11. A description of how the RA will be implemented in a manner that minimizes environmental impacts in accordance with EPA's Principles for Greener Cleanups (Aug. 2009) and any Region 2 Greener Remediation requirements;
12. Preliminary RA Schedule; and
13. Supporting deliverables as specified under the 30% RD in Section 7.2 RD Schedule.

4.5 Intermediate (60%) Remedial Design

In accordance with the schedule in the EPA-approved RDWP Respondent shall submit the Intermediate (60%) RD(s) for EPA's comment. The Intermediate RD(s) shall: (1) be a continuation and expansion of the Preliminary RD; (2) address comments in accordance with EPA's direction regarding the Preliminary RD; and (3) include the same elements as are required for the Preliminary RD unless otherwise approved by EPA.

4.6 Pre-Final Remedial Design

In accordance with the schedule in the EPA-approved RDWP Respondent shall submit the Pre-Final 95% RD(s) for EPA's comment. The Pre-Final Design(s) shall be a continuation and expansion of the previous submittal and shall address comments in accordance with EPA's direction on such documents. The Pre-Final RD(s) will serve as the approved Final RD(s) if EPA approves the Pre-Final RD(s) without comments. The Pre-Final RD(s) must include:

1. A complete set of construction drawings and specifications that are: (i) certified by a Professional Engineer registered in the State; (ii) reproducible and suitable for bid advertisement; and (iii) follow the Construction Specifications Institute's Master Format 2012;
2. The final engineering plans/drawings shall represent an accurate identification of existing site conditions and an illustration of the Work proposed. Drawings shall represent, as necessary, all proposed equipment, improvements, details and other construction and installation items to be developed in accordance with the current standards and guidelines of the State. Drawings shall be submitted in two standard sizes, approximately 24" x 36 and half size. A list of drawing sheet titles shall be provided. A survey and engineering drawings showing existing site elements, site conditions, tide line, property borders, and easements;
3. A final engineer's construction and operation and maintenance cost estimate. This cost estimate shall update the Feasibility Study cost estimate to reflect the details presented in the Final Design;
4. Pre-Final versions of the same elements and deliverables as are required for the Intermediate RD;
5. A discussion of the manner in which the RA will achieve the Performance Standards;
6. A technical specification for photographic documentation of the RA;
7. A specification for project signs at the site. The sign should describe the project, the name of the contractor performing the RD/RA work or the PRP Group, state that the project is being performed under EPA oversight, and provide an EPA contact for further information;
8. Description of Respondent's method for selecting the construction contractor(s); and
9. Supporting deliverables as specified in Section 7.2 RD Schedule.

4.7 Final Remedial Design

In accordance with the schedule in the EPA-approved RDWP Respondent shall submit the Final (100%) RD(s) for EPA approval. The Final RD(s) shall address comments in accordance with EPA's direction on the Pre-final RD(s) and shall include final versions of all Pre-final deliverables.

5.0 REMEDIAL ACTION

5.1 Remedial Action Work Plan

Respondent shall submit a RA Work Plan (RAWP) for EPA approval that includes at a minimum the following:

1. The identity of, contact information for, and description of the roles of the members of Respondent's RA project team, including the Project Coordinator, QA Official and Supervising Contractor; independent QA Official if IQAT is used;
2. A proposed RA Construction Schedule including a schedule for implementing all RA tasks identified in the approved Final Design;
3. Description of plans for satisfying permitting requirements, including obtaining permits for any off-site activity, satisfying ARARs requirements, and for satisfying substantive requirements of permits for on-site activity;
4. Summary of spill control plan or other plans to eliminate or reduce incidence of emissions during construction, and to minimize the impacts of such potential releases to adjacent environments (e.g., wetlands, surface waters, groundwater); and
5. Discussion of and schedule for supporting deliverables or preparation of Supporting Deliverables as specified in Section 7.3 RA Schedule.

5.2 Meetings, Inspections and Reports

5.2.1 Preconstruction Meeting

Respondent shall hold a preconstruction meeting with EPA and others as directed or approved by EPA. The following elements must be addressed at the meeting: methods for documenting and reporting data; methods for distributing and storing documents and reports; methods for assuring health and safety of on-site personnel and area residents; methods for assuring construction quality and methods for restricting site access. Respondent shall prepare, and send to all Parties, minutes of the preconstruction meeting within seven days of the meeting.

5.2.2 Periodic Meetings

During the construction portion of the RA (RA Construction), Respondent shall meet weekly with EPA, and others as directed or determined by EPA, to discuss construction

issues. Respondent shall distribute an agenda and list of attendees to all Parties prior to each meeting. Respondent shall prepare minutes of the meetings and shall distribute the minutes within seven days of the meeting to all Parties.

5.2.3 Inspections

EPA will conduct periodic inspections and have an on-site presence during the Work. Respondent shall provide access to EPA at all times including during any and all periodic inspections. At EPA's request, the Supervising Contractor or other designee shall accompany EPA during inspections.

Respondent shall provide on-site office space for EPA personnel to perform their oversight duties. The minimum office requirements are a private office with at least 150 square feet of floor space, an office desk with an ergonomic chair, personal Dell E-port docking station and compatible computer monitor equipment, access to a secure file cabinet, facsimile, reproduction, and sanitation facilities. A telephone and telephone access along with an internet cable and/or Wi-Fi access is also required. The on-site office shall be made available three days preceding the start of PDI sampling and available until final completion of Work has been approved or otherwise notified by EPA.

Respondent shall provide the appropriate site required personal protective equipment to include hard hats, safety glasses and coveralls for EPA personnel and any oversight officials to perform their oversight duties.

Upon notification by EPA of any deficiencies in the RA Construction, Respondent shall take all necessary steps to immediately correct the deficiencies and/or bring the RA Construction into compliance with the approved Final RD, any approved design changes, and/or the approved RAWP. If applicable, Respondent shall comply with any schedule provided by EPA in its notice of deficiency.

5.2.4 Progress Reports

Commencing with the first month following lodging of the UAO and until EPA issues the Certification of Completion of the RA, Respondent shall submit progress reports to EPA on the fifteenth day of each month, or as otherwise approved by EPA. If requested by EPA, Respondent shall also provide briefings for EPA and/or the State to discuss the progress of the Work. The reports must be submitted in electronic form. The reports must cover all activities that took place during the prior reporting period, including:

1. The actions that have been taken toward achieving compliance with the UAO;
2. A summary of all results of sampling and tests and all other data received or generated by Respondent;
3. A description of all plans, reports, and other deliverables that were submitted;

4. A description of all activities relating to the RA Construction that are scheduled for the next six weeks;
5. Updated RA Construction Schedule; together with information regarding percentage of completion, amount/volume of material removed off-site, unresolved delays encountered or anticipated that may affect the future schedule for implementation of the Work, and a description of efforts made to mitigate those delays or anticipated delays;
6. A description of any modifications to the work plans or other schedules that Respondent has proposed or that have been approved by EPA including descriptions of violations or corrective actions; and
7. A description of all activities undertaken in support of the Community Involvement Plan during the reporting period and those to be undertaken in the next six weeks.
8. Information regarding planned activities for the subsequent two months following the reporting period: a description of all scheduled actions, including data collection, implementation of work plans, and construction progress, including any critical path diagrams such as Gantt charts and Pert charts.
9. A summary of any contractor change orders that have been approved.

5.2.5 Notice of Progress Report Schedule Changes

If the projected schedule for any activity described in the Progress Reports, including activities required to be described under Section 5.2.4 bullet 4 changes, Respondent shall notify EPA of such change at least seven days before performance of the activity and if needed, obtain EPA approval for such schedule changes.

5.2.6 Emergency Reporting

If any action or occurrence during the performance of the Work, which causes or threatens a release of Waste Material from the Site that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, the Respondent shall immediately take all appropriate action to prevent, abate, or minimize such release or threat of release and shall immediately notify the National Response Center at (800) 424-8802 and the appropriate EPA Remedial Project Manager. If the Remedial Project Manager is available, the Respondent shall notify the Chief of the Mega Projects Section of the Emergency and Remedial Response Division of EPA Region 2 at (212) 637-4310 of the incident or Site conditions. The Respondent shall take such actions in consultation with EPA's Remedial Project Manager, or other available authorized EPA officer, and in accordance with all applicable provisions of this Order, including, but not limited to, the Health and Safety Plans, the Contingency Plans, and any other applicable plans or documents developed pursuant to the SOW. In the event that Respondent fails to take appropriate response action as required by this

Paragraph, and EPA takes such action instead, Respondent shall reimburse EPA for all costs of the response action not inconsistent with the NCP, pursuant to Section XI (Payment for Response Costs).

The Respondent shall submit a written report to EPA within 7 days after each such release, setting forth the events that occurred and the measures taken, or to be taken, to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. Within 30 days after the conclusion of such an event, Respondent shall submit a final report setting forth all actions taken in response thereto. This reporting requirement is in addition to, and not in lieu of, reporting under Section 103(c) of CERCLA, 42 U.S.C. §9603(c), and Section 304 of the Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C. §11004, et seq.

5.3 Off-Site Shipments

Respondent may ship hazardous substances, pollutants and contaminants from the site to an off-site facility only if they comply with Section 121(d)(3) of CERCLA, 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440. Respondent will be deemed to be in compliance with CERCLA Section 121(d)(3) and 40 C.F.R. § 300.440 regarding a shipment if Respondent obtain a prior determination from EPA that the proposed receiving facility for such shipment is acceptable under the criteria of 40 C.F.R. § 300.440(b). Respondent may ship Investigation Derived Waste (IDW) from the site to an off-site facility only if Respondent comply with EPA's Guide to Management of Investigation Derived Waste, OSWER 9345.3-03FS (Jan. 1992).

Respondent may ship Waste Material from the site to an out-of-state waste management facility only if, prior to any shipment; they provide notice to the appropriate state environmental official in the receiving facility's state and to the EPA Project Coordinator. This notice requirement will not apply to any off-site shipments when the total quantity of all such shipments will not exceed ten cubic yards. The notice must include the following information, if available: (1) the name and location of the receiving facility; (2) the type and quantity of Waste Material to be shipped; (3) the schedule for the shipment; and (4) the method of transportation. Respondent also shall notify the state environmental official referenced above and the EPA Project Coordinator of any major changes in the shipment plan, such as a decision to ship the Waste Material to a different out-of-state facility. Respondent shall provide the notice after the award of the contract for Remedial Action construction and before the Waste Material is shipped.

5.4 Remedial Action Construction Completion

5.4.1 RA Construction Completion Inspection

Respondent may schedule an inspection for the purpose of obtaining EPA's approval of the completion of the RA Construction Phase. The inspection must be attended by Respondent and EPA and/or their representatives. A reinspection must be conducted if requested by EPA.

If EPA concludes that the RA is not Complete, EPA must so notify Respondent. EPA's notice must describe any deficiencies. The Respondent shall submit specifications and a schedule for EPA approval within the timeframe specified in EPA's notice. Respondent shall perform all activities in the EPA-approved specifications and schedule.

5.5 Certification of Completion of the Remedial Action

5.5.1 RA Completion Inspection

The RA is "Complete" for purposes of this section when it has been fully performed and the Performance Standards have been achieved. Respondent shall schedule an inspection for the purpose of obtaining EPA's Certification of Completion of the RA. The inspection must be attended by Respondent and EPA and/or their representatives.

5.5.2 RA Monitoring Report

The Respondent shall submit a RA Monitoring Report to EPA requesting EPA's Certification of Completion of the RA. The report must: (1) include certifications by a registered professional engineer and by Respondent's Project Coordinator that the RA is complete; (2) be prepared in accordance with EPA's *Close Out Procedures for NPL Sites* guidance (May 2011) or most recent version; (3) contain monitoring data to demonstrate that performance standards have been achieved; and (4) be certified in accordance with Section 6.2.1.

If EPA concludes, based on the initial or any subsequent report requesting Certification of Completion of the RA, that the RA is Complete, EPA must so certify to Respondent. This certification will constitute the Certification of Completion of the RA for purposes of the UAO. Certification of Completion of the RA will not affect Respondent's remaining obligations under the UAO.

5.6 Certification of Completion of the Work

5.6.1 Work Completion Inspection

Respondent shall schedule an inspection for the purpose of obtaining EPA's Certification of Completion of the Work. The inspection must be attended by Respondent, EPA and their representatives.

5.6.2 Work Completion Report

Following the inspection, Respondent shall submit a report to EPA requesting EPA's Certification of Completion of the Work. The report must: (a) include certifications by a registered professional engineer and by Respondent's Project Coordinator that the Work, including all O&M activities, is complete; and (b) be certified in accordance with Section 6.2.1. If the RA Report submitted under Section 5.4.2 includes all elements required under this Section 5.6.2, then the RA Report suffices to satisfy all requirements under this Section 5.6.2.

Pre-final Construction Inspection - When Respondent makes a determination that construction is complete for a component of the RA, they shall notify EPA, schedule and conduct with EPA a pre-final construction inspection for that component. The purpose of the inspection is to determine whether the construction of the component is complete and complies with the final remedial design and the approved RAWP. The pre-final inspection shall include a walkthrough inspection of the facilities constructed for that component of the RA. Respondent shall certify that the equipment performs to meet the purpose and intent of the specifications. EPA shall identify and note any outstanding construction and/or operation items found during the inspection.

Pre-final Construction Inspection Report - Respondent shall submit, after each Pre-final Construction Inspection, a Pre-final Construction Inspection Report for that component of the RA after completion of a Pre-final Construction Inspection for that component. This report shall describe all outstanding construction and/or operation items, all actions required to resolve these items, the proposed completion date for these items, and a proposed date for the final inspection.

Final Construction Inspection - The Respondent will schedule and conduct, with EPA's approval, a final construction inspection for each component of the RA, after completion of work identified in the Pre-final Construction inspection Report. This inspection shall include another walkthrough of the facilities constructed as part of that component. The Respondent and the RPM shall use the Pre-final Construction Inspection Report as a checklist during this inspection.

5.4.2 RA Report

Following the completion of construction activities, Respondent shall submit an "RA Report" requesting EPA's approval of the Construction Phase and EPA's determination that the RA is operating as intended. The RA Report must: (1) include statements by a registered professional engineer and by Respondent's Project Coordinator that the Construction Phase is complete; (2) include supporting documentation (with a summary of the documentation), that the Construction Phase is complete; (3) be prepared in accordance with Chapter 2 (Remedial Action Completion) of EPA's *Close Out Procedures for NPL Sites* guidance (May 2011); and (4) be certified in accordance with Section 6.2.1.

If EPA concludes that the RA Construction is not complete, or the RA is not performing as designed, EPA must so notify Respondent. EPA's notice must include a description of the activities that Respondent must perform in order to complete the RA Construction or cause the RA to operate as intended. Respondent shall submit specifications and a schedule for EPA's approval. Respondent shall perform all activities described in the notice or in the EPA-approved specifications and schedule.

If EPA concludes, based on the initial or any subsequent RA report, that the Construction Phase is complete and the RA is operating as intended, EPA must so notify the Respondent.

If EPA concludes that the Work is not complete, EPA must notify Respondent. EPA's notice will describe any deficiencies. The Respondent shall submit specifications and a schedule for EPA approval within the timeframe specified in EPA's notice. Respondent shall perform all activities in the EPA-approved specifications and schedule.

If EPA concludes, based on the initial or any subsequent report requesting Certification of Completion of the Work, that the Work is complete, EPA must so certify in writing to Respondent.

6.0 DELIVERABLES

6.1 Applicability

Sections 6.2 and 6.3 apply to any deliverable that is required to be submitted for EPA approval. All deliverables required pursuant to this SOW are subject to review and approval by EPA pursuant to Section XIV of the UAO. Paragraph 6.2 also applies to any deliverable that is required to be submitted for EPA comment.

6.2 General Requirements

All communications specified in this SOW, including approvals, consents, deliverables, modifications, notices, notifications, objections, proposals, and/or requests, must be in writing unless otherwise specified.

All deliverables must be submitted by the deadlines in the RD Schedule or RA Schedule, as applicable. All deliverables must be delivered to EPA in hardcopy and electronic format (e.g. CD disk), as applicable. The number of copies will be determined at the time of delivery. EPA shall reserve the right to request a deliverable in a specified word processing software format.

6.2.1 Required Certification for Deliverables

All plans, reports, or other deliverables that require compliance with this Paragraph must be signed by the Respondent's Project Coordinator, or other responsible official of a Respondent, and must contain the following statement:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

6.2.2 Technical Specifications for Deliverables

Sampling and monitoring data contained in any deliverables must be submitted in EPA Region 2 Electronic Data Deliverable (EDD) format. U.S EPA Region 2 EDD format can be found at: <http://www.epa.gov/region2/superfund/medd.htm>.

6.3 Supporting Deliverables

Respondent shall submit each of the following supporting deliverables for EPA approval. The deliverables must be submitted, for the first time, by the deadlines in the RD Schedule or the RA Schedule, or any other EPA-approved schedule, as applicable. Respondent shall develop the deliverables in accordance with all applicable regulations, guidances and policies. Respondent shall update each of these supporting deliverables as necessary or appropriate during the course of the Work, and/or as requested by EPA.

6.3.1 Construction Quality Assurance/Quality Control Plan

The purpose of the Construction Quality Assurance Plan (CQAP) is to describe planned and systemic activities that provide confidence that the RA construction will satisfy all design criteria, plans, specifications, and related requirements, including quality objectives. The CQAP shall address sampling, analysis and monitoring to be performed during the remedial construction phase of the Work. The CQA/QCP shall:

1. Identify, and describe the responsibilities of, the organizations and personnel implementing the Construction QA/QC including identification of a QA Official independent of the RA Contractor to conduct a QA program during the RA phase of the project;
2. Describe verification activities, such as inspections, sampling, testing, monitoring and production controls, under the Construction QA/QC;
3. Identify and describe monitoring, measurement, sampling, testing and daily logging procedures to establish whether the RA construction is performed in compliance with design specifications, ARARs, and performance standards. This shall include identification of the sample size, locations, frequency of testing, acceptance and rejection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports and final documentation;
4. Describe industry standards and technical specifications used in implementing the Construction QA/QC;
5. Describe procedures for tracking construction deficiencies from identification through corrective action;
6. Describe procedures for documenting all Construction QA/QC activities; and
7. Describe procedures for retention of documents and for final storage of documents.

6.3.2 Emergency Response Plan

The Emergency Response Plan (ERP) must describe procedures to be used in the event of an accident or emergency at the site (for example, power outages, water impoundment failure, treatment plant failure, slope failure, etc). The ERP shall include:

1. Name of the person or entity responsible for responding in the event of an emergency incident;
2. Plan and date(s) for meeting(s) with the local community, including local, State and Federal agencies involved in the cleanup, as well as local emergency squads and hospitals;
3. Spill Prevention, Control, and Countermeasures (SPCC) Plan (if applicable), as specified in 40 C.F.R. Part 109, describing measures to prevent, and contingency plans for, potential spills and discharges from materials handling and transportation;
4. Notification activities in accordance with Section 5.2.6 in the event of a release of hazardous substances requiring reporting under Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act (EPCRA), 42 U.S.C. § 11004; and
5. A description of all necessary actions to ensure compliance with Section XIII (Endangerment and Emergency Response) of the UAO in the event of an occurrence during the performance of the Work that causes or threatens a release of Waste Material from the site that constitutes an emergency or may present an immediate threat to public health or welfare or the environment.

6.3.3 Health and Safety Plan

The Health and Safety Plan (HASP) describes all activities to be performed to protect on-site personnel and area residents from physical, chemical and all other hazards posed by the Work. Respondent shall develop the HASP in accordance with EPA's Emergency Responder Health and Safety and OSHA requirements under 29 C.F.R. §§ 1910 and 1926. The HASP also must address monitoring and control measures to protect the community during the Work.

6.3.4 Performance Standards Verification Plan

The Performance Standards Verification Plan (PSVP) describes activities to verify that all Performance Standards are satisfied and includes a schedule for performing these activities. The PSVP shall include the following elements:

1. A description of each of the Performance Standards as identified in Section 1.0;

2. A description of plans to provide confidence that each Performance Standard will be met; and
3. A description of activities to be performed to determine whether Performance Standards have been met. A FSP and QAPP shall be included for any environmental sampling required.

6.3.5 Five-Year Policy Review Support Plan

The Five-Year Policy Review Support Plan addresses the studies and investigations that Respondent shall conduct at the request of EPA to support EPA's reviews of whether the Remedial Action is protective of human health and the environment in accordance with Section 121(c) of CERCLA, 42 U.S.C. § 9621(c). Respondent shall develop the plan in accordance with Comprehensive Five-year Review Guidance, OSWER 9355.7-03B-P (June 2001), and any other relevant five-year review guidance. The ROD anticipates that although a five-year review would not be required since this Remedy results in an unlimited use/unrestricted exposure scenario, a policy review may be conducted within five years of completion of construction if all Remedial Action Objectives (RAOs) have not yet been achieved.

6.3.6 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPP) addresses sample collection, all sample analysis and data handling regarding the Work.

The QAPP must include a detailed explanation of Respondent's quality assurance, quality control, and chain of custody procedures for all treatability, design, compliance, and monitoring samples.

Respondent shall develop the QAPP in accordance with Guidance for Quality Assurance Project Plan, Uniform Federal Policy for Quality Assurance Project Plans, Parts 1-3, EPA/505/B-04/900A through 900C (March 2005). EPA protocol and guidance documents are provided on the EPA Region 2 Quality Assurance homepage at: <http://www.epa.gov/region2/qa/documents.htm>.

The QAPP also must include procedures:

1. To ensure that EPA and the State and their authorized representative have reasonable access to laboratories used by Respondent in implementing the UAO ("Respondent's Labs");
2. To ensure that Respondent's Labs analyze all samples submitted including performance evaluation samples pursuant to the QAPP for quality assurance monitoring;
3. To ensure that Respondent's Labs perform all analyses using EPA-accepted methods as approved by EPA;

4. To ensure upon receipt from the laboratory, all data shall be validated in accordance with EPA Region 2 data validation Standard Operating Procedures available at: <http://www.epa.gov/region02/qa/documents.htm>. EPA reserves the right to perform an independent data validation, data validation check, or qualification check on generated data.
5. To ensure deliverables are equivalent to the EPA Contract laboratory Program (CLP) data packages from the laboratory for analytical data. Upon EPA's request, Respondent shall submit to EPA the full documentation (including raw data) for this analytical data
6. To ensure that Respondent's Laboratories are accredited with a national organization such as: the National Environmental Laboratory Accreditation Program (NELAP) or the American Association for Laboratory Accreditation (A2LA). Alternatively, if the laboratory participates in the CLP, this requirement will be considered as fulfilled;
7. For Respondent to provide EPA and the State with notice at least 28 days prior to any sample collection activity;
8. For Respondent to provide split samples and/or duplicate samples to EPA and the State upon request;
9. For EPA to take any additional samples that they deem necessary;
10. For EPA to provide to Respondent, upon request, split samples and/or duplicate samples in connection with EPA's and the State's oversight sampling; and
11. For Respondent to submit to EPA all sampling and tests results and other data in connection with the implementation of the UAO.

6.3.7 Site Wide Monitoring Plan

The ROD requires that monitoring will be implemented to ensure the effectiveness of the remedy by achieving the remedial goals presented in Table 5-2 (1-1 in the SOW). The Site Wide Monitoring Plan (SWMP), at a minimum, shall include:

1. Description of the environmental media to be monitored and site security needs and provisions;
2. Description of the constraints and parameters imposed on the project by outside entities, including property owners, operating businesses, local agencies, etc., and a plan for accommodating these constraints in the implementation of the RA.

3. Description of the data collection parameters, including existing and proposed monitoring devices and locations, frequency of monitoring, analytical parameters to be monitored and analytical methods employed;
4. Description of how performance data will be analyzed, interpreted and reported, and/or other site-related requirements; and
5. Description of proposed contingency actions in the event that results from monitoring devices indicate higher than expected concentrations of the contaminants of concern, such as increases in frequency of monitoring, installation of additional monitoring devices in the affected areas and/or other changed condition, such as increasing surface water contaminant concentrations, etc.

6.3.8 Transportation and Off-Site Disposal Plan

The Transportation and Off-Site Disposal Plan (TODP) describes plans to ensure compliance with Section 5.3 (Off-Site Shipments). The TODP must include:

1. Proposed routes for off-site shipment of waste material;
2. Identification of communities affected by shipment of waste material; and
3. Description of plans to minimize impacts on affected communities.

7.0 SCHEDULES

7.1 Applicability and Revisions

All deliverables and tasks required under this SOW must be submitted or completed by the deadlines or within the time durations listed in the RD and RA Schedules. The initial RD and RA Schedules are set forth below. Upon EPA's request, Respondent shall submit proposed revised RD Schedules or RA Schedules for EPA approval.

7.2 Remedial Design Schedule

Line	Description of Deliverable / Task / Supporting Deliverable	Section Reference	Deadline
1	Designate Community Affairs Liaison	3.1	15 days after EPA request

2	Remedial Design Work Plan (including HASP, ERP, QAPP, SWMP)	4.1, 6.3	45 days after EPA's authorization to proceed with Supervising Contractor
3	Treatability Study Work Plan (TSWP)	4.2	45 days after EPA's authorization to proceed with Supervising Contractor
4	TS Evaluation Report	4.2	60 days after receipt of validated data
5	Pre-Design Investigation Work Plan (PDIWP)	4.3	45 days after EPA's authorization to proceed with Supervising Contractor
6	Preliminary RD (30%) (including CQA/QCP, O&M Manual, PSVP, TODP)	4.4	30 days after EPA approval of Final RDWP
7	Intermediate RD (60%)	4.5	21 days after EPA comments on Preliminary RD
8	Pre-final RD (95%)	4.6	14 days after EPA Comments on Intermediate RD
9	Final Remedial Design	4.7	7 days after EPA approval on PDI Evaluation Report
10	PDI Start	4.3	7 days after EPA comments on Pre-final RD
11	PDI Evaluation Report	4.3.1	60 days after receipt of validated data
12	Remedial Action Work Plan	5.1	21 days after EPA comments on Pre-final RD

7.3 Remedial Action Schedule

Line	Description of Deliverable / Task	Section Reference	Deadline
1	Award Remedial Action (RA) contract	5.1	30 days after EPA Notice of Authorization to Proceed with RA
2	Pre-Construction Meeting	5.2.1	14 days after Award of RA contract(s)
3	Start of Construction		21 days after Pre-Construction Meeting

4	Completion of Construction		
5	Pre-final Construction Inspection	5.4.1	14 days after completion of construction
6	Pre-final Construction Inspection Report	5.4.1	21 days after completion of Pre-final Inspection
7	Final Construction Inspection	5.4.1	14 days after Completion of Work identified in Pre-final Inspection Report
8	RA Report	5.4.2	21 days after Final Inspection
9	RA Monitoring Report	5.5.2	21 days after Final Inspection
10	Work Completion Report	5.6.2	30 days after EPA approval on RA Monitoring Report
11	Five Year Policy Review Support Plan	6.3.5	30 days after EPA request

8.0 STATE PARTICIPATION

8.1 Copies

Respondent shall at a minimum submit two hardcopies and two electronic (disk or thumb drive) copies of all deliverables. The number of copies shall be confirmed in writing prior to delivery of all deliverables. Respondent shall, at any time they send a notice, report, deliverable or submission to EPA, send a copy of such document to the State. EPA may, at any time it sends a notice, authorization, approval, disapproval or certification to Respondent, send a copy of such document to the State.

8.2 Review and Comment

The State will have a reasonable opportunity for review and comment prior to:

1. Any EPA approval or disapproval under Section 6.3 of any plans, reports or other deliverables that are required to be submitted for EPA approval; and
2. Any approval or disapproval of the Construction Phase under Section 5.4, any disapproval of, or certification of completion of the RA under Section 5.5, and any disapproval of, or certification of completion of the Work under Section 5.6.

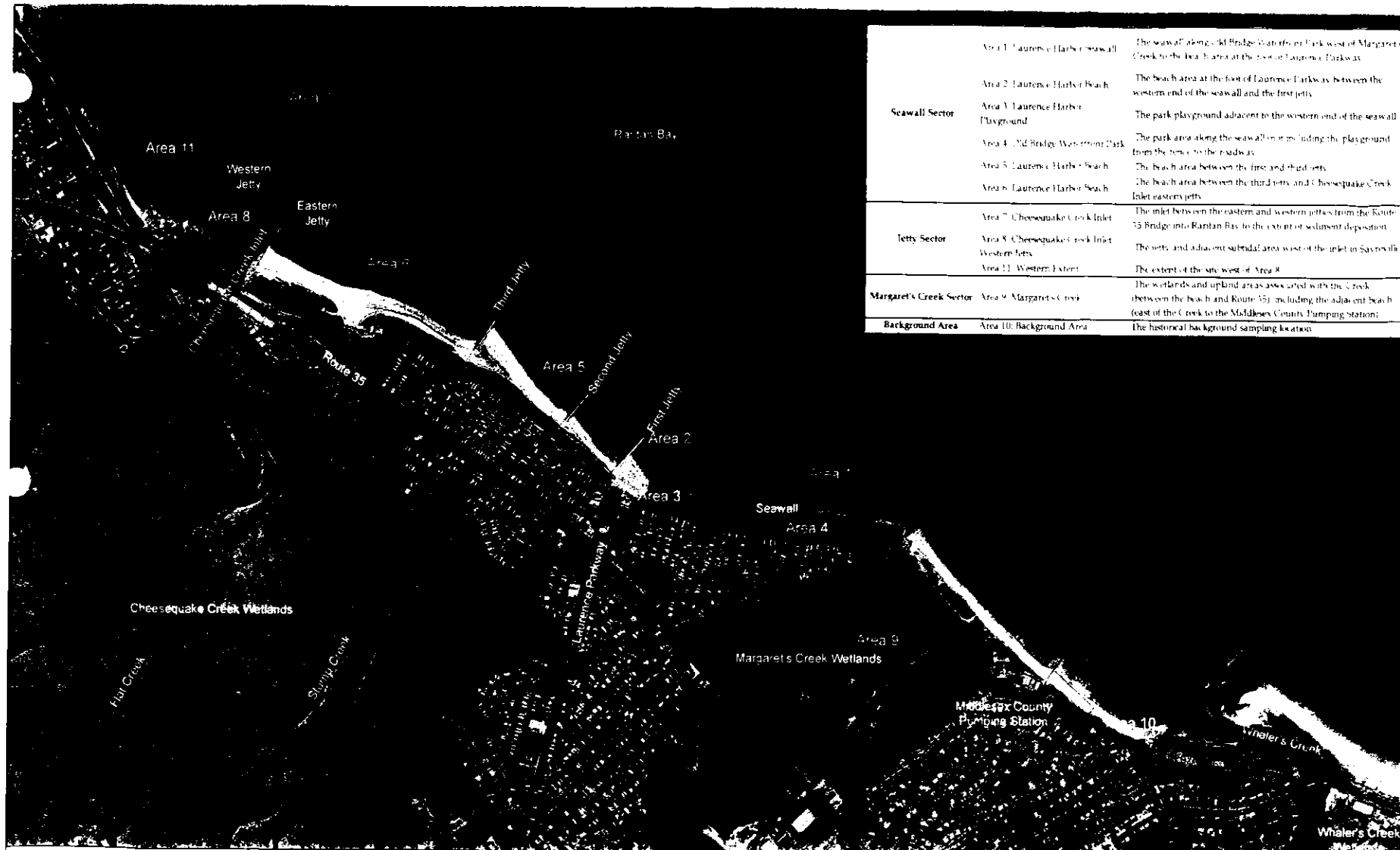
9.0 REFERENCES

The following regulations and guidance documents, among others, apply to the Work. A more complete list may be found on the following EPA Web pages:

1. Laws, Policy and Guidance <http://www.epa.gov/superfund/policy/index.htm>
2. Test Methods Collections <http://www.epa.gov/fem/methcollectns.htm>
3. For any regulation or guidance referenced in the UAO or SOW, the reference will be read to include any subsequent modification, amendment or replacement of such regulation or guidance. Such modifications, amendments or replacements apply to the Work only after Respondent receive notification from EPA of the modification, amendment or replacement.
4. A Compendium of Superfund Field Operations Methods, OSWER 9355.0-14, EPA/540/P-87/001a (August 1987).
5. CERCLA Compliance with Other Laws Manual, Part I: Interim Final, OSWER 9234.1-01, EPA/540/G-89/006 (August 1988).
6. Guidance for Conducting Remedial Investigations and Feasibility Studies, OSWER 9355.3-01, EPA/540/G-89/004 (October 1988).
7. CERCLA Compliance with Other Laws Manual, Part II, OSWER 9234.1-02, EPA/540/G-89/009 (August 1989).
8. Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties, OSWER 9355.5-01, EPA/540/G-90/001 (April 1990).
9. Guidance on Expediting Remedial Design and Remedial Actions, OSWER 9355.5-02, EPA/540/G-90/006 (August 1990).
10. Guide to Management of Investigation-Derived Wastes, OSWER 9345.3-03FS (January 1992).
11. Permits and Permit Equivalency Processes for CERCLA On-Site Response Actions, OSWER 9355.7-03 (February 1992).
12. Guidance for Conducting Treatability Studies under CERCLA, OSWER 9380.3-10, EPA/540/R-92/071A (November 1992).
13. National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule, 40 C.F.R. Part 300 (October 1994).

14. Guidance for Scoping the Remedial Design, OSWER 9355.0-43, EPA/540/R-95/025 (March 1995).
15. Remedial Design/Remedial Action Handbook, OSWER 9355.0-04B, EPA/540/R-95/059 (June 1995).
16. EPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis, QA/G-9, EPA/600/R-96/084 (July 2000).
17. Operation and Maintenance in the Superfund Program, OSWER 9200.1-37FS, EPA/540/F-01/004 (May 2001).
18. Comprehensive Five-year Review Guidance, OSWER 9355.7-03B-P, 540-R-01-007 (June 2001).
19. Guidance for Quality Assurance Project Plans, QA/G-5, EPA/240/R-02/009 (December 2002).
20. Quality Systems for Environmental Data and Technology Programs -- Requirements with Guidance for Use, ANSI/ASQ E4-2004 (2004).
21. Uniform Federal Policy for Quality Assurance Project Plans, Parts 1-3, EPA/505/B-04/900A through 900C (March 2005).
22. Superfund Community Involvement Handbook, EPA/540/K-05/003 (April 2005).
23. EPA Guidance on Systematic Planning Using the Data Quality Objectives Process, QA/G-4, EPA/240/B-06/001 (February 2006).
24. EPA Requirements for Quality Assurance Project Plans, QA/R-5, EPA/240/B-01/003 (March 2001, reissued May 2006).
25. EPA Requirements for Quality Management Plans, QA/R-2, EPA/240/B-01/002 (March 2001, reissued May 2006).
26. USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4 (Dec. 2006).
27. USEPA Contract Laboratory Program Statement of Work for Organic Analysis, SOM01.2 (amended April 2007).
28. Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration, OSWER 9283.1-33 (June 2009).
29. Principles for Greener Cleanups (August 2009),
<http://www.epa.gov/oswer/greenercleanups/>.

30. Providing Communities with Opportunities for Independent Technical Assistance in Superfund Settlements, Interim (September 2009).
31. USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods (Multi-Media, Multi-Concentration), ISM01.2 (January 2010).
32. Close Out Procedures for National Priorities List Sites, OSWER 9320.2-22 (May 2011).
33. Groundwater Road Map Recommended Process for Restoring Contaminated Groundwater at Superfund Sites, OSWER 9283.1-34 (July 2011).
34. Construction Specifications Institute's MasterFormat 2012, available from the Construction Specifications Institute, www.csinet.org/masterformat.
35. Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance," OSWER 9355.7-18 (September 2011).
36. Updated Superfund Response and Settlement Approach for Sites Using the Superfund Alternative Approach (SAA Guidance), OSWER 9200.2-125 (September 2012).
37. Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, OSWER 9355.0-89, EPA/540/R-09/001 (December 2012).
38. Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites, OSWER 9200.0-77, EPA/540/R-09/02 (December 2012).
39. EPA's Emergency Responder Health and Safety Manual, OSWER Directive 9285.3-12 (July 2005 and updates). http://www.epaossc.org/_1healthSafetyManual/manual-index.htm



Seawall Sector	Area 1: Lawrence Harbor Seawall	The seawall along Old Bridge Waterfront Park west of Margaret's Creek to the beach area at the foot of Lawrence Parkway.
	Area 2: Lawrence Harbor Beach	The beach area at the foot of Lawrence Parkway between the western end of the seawall and the first jetty.
	Area 3: Lawrence Harbor Playground	The park playground adjacent to the western end of the seawall.
	Area 4: Old Bridge Waterfront Park	The park area along the seawall on the east including the playground from the jetties to the roadway.
	Area 5: Lawrence Harbor Beach	The beach area between the first and third jetties.
	Area 6: Lawrence Harbor Beach	The beach area between the third jetty and Cheesequake Creek Inlet eastern jetty.
Jetty Sector	Area 7: Cheesequake Creek Inlet	The inlet between the eastern and western jetties from the Route 35 Bridge into Raritan Bay to the extent of sediment deposition.
	Area 8: Cheesequake Creek Inlet Western Jetty	The jetties and adjacent subtidal area west of the inlet in Sayreville.
	Area 11: Western Extent	The extent of the site west of Area 8.
Margaret's Creek Sector	Area 9: Margaret's Creek	The wetlands and upland areas associated with the Creek between the beach and Route 35, including the adjacent beach (east of the Creek to the Middlesex County Pumping Station).
Background Area	Area 10: Background Area	The historical background sampling location.



0 1,000 2,000 4,000 Feet



Figure 1-2
Investigation Areas
Raritan Bay Slag Superfund Site
Old Bridge and Sayreville, New Jersey

Appendix C